INDEX

COURSE STRUCTURE

B.TECH.

COMPUTER SCIENCE & ENGINEERING

Specialization

in

Artificial Intelligence and Machine Learning

Under

Choice Based Credit System (CBCS)

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Program Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals, researchers or entrepreneurs, for developing sustainable solutions.

PEO2: Attain positions of leadership in an organization and /or on teams.

PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Program Specific Outcomes (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.

PSO2: Design and develop hardware and software interfaces along with latest tools and technology to meet the needs of industry.

PSO3: Analyze the algorithmic principles, theory of computation, artificial intelligence and mathematical foundations for the modeling and design of computing systems.

PSO4: Apply knowledge to provide innovative solutions to existing problems and identify research gaps.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics and science, with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE.

PO2: Problem Analysis: Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of solutions: Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations.

PO4: Conduct Investigations of Complex problems: Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development

PO8: Ethics: Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

PO12: Life-Long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change.

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BPHS0001	Engineering Physics	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication – I	2	0	0	2	2
4.	BECG0001	Electronics Engineering	3	1	0	4	4
5.	BCSG0001	Python Programming	4	1	0	5	5
PRACTICALS							
7.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
8.	BELH0801	English Language Lab – I	0	0	2	1	2
9.	BECG0800	Electronics Lab I	0	0	2	1	2
10.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
11.	BCSG0800	Python Programming Lab	0	0	2	1	2
		TOTAL	**15**	**4**	**10**	**24**	**29**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BCHS0101	Engineering Chemistry	3	1	0	4	4
3.	BELH0002	English Language Skills for Communication – II	2	0	0	2	2
4.	BEEG0001	Electrical Engineering	3	1	0	4	4
5.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
6.	BCSC2001	Computer Programming	3	0	0	3	3
7.	BCSC0606	Introduction to Artificial Intelligence	3	0	0	3	3
PRACTICALS							
8.	BCHS0801	Engineering Chemistry Lab	0	0	2	1	2
9.	BELH0802	English Language Lab – II	0	0	2	1	2
10.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
11.	BCSC0800	Computer Programming Lab	0	0	2	1	2
		TOTAL	**20**	**4**	**8**	**28**	**32**

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BCSC2001	Computer Programming	3	0	0	0	3	3	
2.	BCSC0002	Object Oriented Programming	3	0	0	0	3	3	Programming
3.	BCSC0003	Database Management System	3	0	0	0	3	3	
4.	BCSC0004	Operating Systems	3	0	0	0	3	3	
5.	BCSC0005	Computer Organization	3	0	0	0	3	3	
6.	BCSC0006	Data Structures & Algorithms	3	1	0	0	4	4	Programming
7.	BCSC0007	Introduction to Microprocessors	3	0	0	0	3	3	Computer Organization
8.	BCSC0008	Computer Networks	3	1	0	0	4	4	
9.	BCSC0009	Software Engineering	3	0	0	0	3	3	
10.	BCSC00010	Discrete Mathematics	3	1	0	0	4	4	
11.	BCSC0011	Theory of Automata & Formal Language	3	1	0	0	4	4	
12.	BCSC0012	Design & Analysis of Algorithms	3	0	0	0	3	3	Data Structures
13.	BCSC0606	Introduction to Artificial Intelligence	3	0	0	0	3	3	
14.	BCSC0015	Applied Data Structures and Algorithms	4	1	0	0	5	5	
PRACTICALS									
1.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
2.	BCSC0801	Object Oriented Programming Lab	0	0	2	0	1	2	
3.	BCSC0802	Database Management System Lab	0	0	2	0	1	2	
4.	BCSC0803	Operating Systems Lab	0	0	2	0	1	2	
5.	BCSC0804	Computer Organization Lab	0	0	2	0	1	2	
6.	BCSC0805	Data Structures & Algorithms Lab	0	0	2	0	1	2	Programming Lab
7.	BCSC0806	Microprocessors Lab	0	0	2	0	1	2	
8.	BCSC0807	Design & Analysis of Algorithms Lab	0	0	2	0	1	2	Programming, Data Structures
9.	BCSC0808	Applied Database Management System	0	0	2	0	1	2	
		Total	**43**	**5**	**18**	**0**	**57**	**66**	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Specialization In Artificial Intelligence And Machine Learning									
THEORY									
1.	BCSE0701	Introduction To Machine Learning	3	0	0	0	3	3	
2.	BCSE0702	Algorithm for Intelligent Systems and Robotics	2	0	0	0	2	2	
3.	BCSE0703	Data mining & Predictive Modeling	2	0	0	0	2	2	
4.	BCSE0704	Computational Linguistics and Natural Language Processing	2	0	0	0	2	2	
5.	BCSE0705	Application of Machine Learning in industries	2	0	0	0	2	2	
6.	BCSE0706	Neural Networks	3	0	0	0	3	3	
7.	BCSE0707	Cognitive Analytics	2	0	0	0	2	2	
8.	BCSE0708	Pattern and Anomaly Detection	3	0	0	0	3	3	
PRACTICALS									
1.	BCSE0731	Introduction To Machine Learning Lab	0	0	2	0	1	2	
2,	BCSE0732	Algorithm for Intelligent Systems and Robotics Lab	0	0	2	0	1	2	
3.	BCSE0733	Data mining & Predictive Modeling Lab	0	0	2	0	1	2	
4.	BCSE0734	Computational Linguistic and Natural Language Processing Lab	0	0	2	0	1	2	
5.	BCSE0735	Application of Machine Learning in Industries Lab	0	0	2	0	1	2	
6.	BCSE0736	Neural Networks Lab	0	0	2	0	1	2	
15.	BCSE0737	Cognitive Analytics Lab	0	0	2	0	1	2	
16.	BCSE0738	Pattern and Anomaly Detection Lab	0	0	2	0	1	2	
Total			**19**	**0**	**16**	**0**	**27**	**35**	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BCSJ0950	Mini Project – I	0	0	0	0	2	0	
2.	BCSJ0951	Mini Project – II	0	0	0	0	2	0	
3.	BCSJ0971	Project – Part I	0	0	0	0	3	0	
4.	BCSJ0972	Project – Part II	0	0	0	0	8	0	
5.	BCSJ0991	Industrial Training	0	0	0	0	2	0	
		TOTAL	**0**	**0**	**0**	**0**	**17**	**0**	

Mandatory Non Graded Course

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
5.	BCHM0202	Environmental Studies	2	0	0	0	2	2	
6.	BELM0001	Introduction to Bhagavad Gita	2	0	0	0	2	2	
		TOTAL	**12**	**0**	**0**	**0**	**0**	**12**	

Humanities and Social Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purposes – I	2	0	0	0	2	2	
4.	BELH0004	English for Professional Purposes – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAH0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	8	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	8	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
		THEORY							
1.	BEEG0001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BCSG0001	Python Programming	4	1	0	0	5	5	
		PRACTICALS							
5.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
6.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
7.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
8.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
9.	BCSG0800	Python Programming Lab	0	0	2	0	1	2	

BCSG0001: PYTHON PROGRAMMING

Objective: *This course introduces the solving of mathematical problems using Python programming using OO concepts and its connectivity with database.*

Credits:05 **L-T-P-J:4-1-0-0**

Module No.	Content	Teaching Hours
I	Introduction to Python: Introduction and Basics; Setting up path Python Data Variables & Operators: Data Variables and its types, id () and type () functions, Coding Standards; **Control Structures:** if-else, elif, Nested if, Iteration Control structures, Break, Continue & Pass; **String Manipulation:** Accessing Strings, Basic Operations, String slices Function and Methods. **Lists:** Introduction, Accessing list, Operations, Working with lists, Function and Methods. **Tuple:** Introduction, accessing tuples , Operations, Working, Functions and Methods. **Dictionaries:** Introduction, accessing values in dictionaries, Working with dictionaries, Properties ,Functions.	22
II	**Functions:** Defining & Calling a function, Passing arguments to functions – Mutable & Immutable Data Types, Different types of arguments, Recursion, Scope of variables; **Modules and Packages:** User-defined modules and Standard Library: random, numpy, scipy, sys, Math Module, String Module, List Module, Date & Time Module, Regular Expressions: match, search, replace; **Input-Output:** Printing on screen, reading data from keyboard, Opening and closing file, Reading and writing files, Functions. **Exception Handling:** Exception, Exception Handling, except clause, try? finally clause, User Defined Exceptions. Basics of Python for Data Analysis, Introduction to series and dataframes & Python using Pandas.	22

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1, CO2, CO3,CO6,CO7.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of Python Programming.
- CO2: Apply the concepts of control structures and string manipulations of python programming.
- CO3: Understand the use of data structures available in Python List, Tuple and Dictionary.
- CO4: Experiment user-defined functions and access built-in functions.
- CO5: Experiment user-defined modules and access built-in modules- math, random, string, date, time, date time.
- CO6: Develop the programs using the concept of File Handling.
- CO7: Develop programs based on Exceptional Handling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO4
CO2	PO4/PSO1
CO3	PO5/PSO4
CO4	PO5,PO7/PSO1
CO5	PO2,PO8/PSO4
CO6	PO3,PO10/PSO2
CO7	PO5,PO9/PSO1

BCSC2001: COMPUTER PROGRAMMING

Objective: *To impart adequate knowledge on the need of problem solving techniques and develop programming skills to implements applications using the concepts of C Language. Also by learning the programming constructs they can easily switch over to any other language in future.*

Credits:05 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Generation of Programming Languages:** Low, Assembly, High and 4GL. **Language Processors:** Compiler, Interpreter, Assembler, Linker and Loader. **Algorithm:** Introduction, Features, Different Ways of stating Algorithms. **Flow Chart:** Introduction, Standard, Guidelines, Advantages and Limitations of using Flowcharts. **Basics of C:** Overview, Structure of a C program, Identifier, Keywords, Variables, Data types, Formatted Input and output. **Operators and Expression:** Assignment, Unary, Arithmetic, Relational, Logical, Bitwise, Conditional, Special operators and their precedence & Associatively . IEEE representation of data types like float & double, L value and R value **Type Conversion:** Type Promotion in expression, Conversion by Assignment, Truncation and Casting Arithmetic expression. **Decision and Case Control Structure:** if, if-else, nested if-else, Decisions using switch, switch versus if-else ladder, goto. **Loop Control Structure:** For loop, while loop, do-while loop, nesting of loops, break, and continue. **Arrays:** Introduction, one-dimensional and two-dimensional Array-Declaration, Initialization, Address Calculation. **Operations on Arrays:** Insertion, Deletion, Linear Search & Bubble Sort. **String:** Introduction, One dimensional and two dimensional Array-Declarations, Initialization **Operations on String:** Length, Copy, Reverse, Concatenate, Compare with & without built-in functions.	25
II	**Functions:** Declaration and Definition, Category of Functions, Parameter Passing Techniques – Call by Value, Passing Arrays to Functions. **Introduction to Storage Classes:** Auto, Static, Extern and Register. **Recursion:** Mechanics of Recursive Call, Implementation of Recursion, Recursion vs. Iteration. **The C Preprocessor:** Introduction, Macro Expansion and File Inclusion, Conditional Compilation and Miscellaneous Directives. **Pointers:** Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Arrays and Pointers, Pointer and Strings, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointer to an Array, Two Dimensional Array and Pointers, Pointers to Functions, Dynamic Memory Allocation, void Pointer and Null Pointer. **User Defined Types:** enum , typedef, Union and Structure - Declaration, Initialization, Nested Structures, Arrays of Structures, Structure and Pointer, Passing Structure Through Function. Difference between Structures and Union. **File Handling:** Data and Information, File Concepts, File Organization, File Operations: Open, Read, and Close, Trouble in Opening a File. File Opening Modes, Working with Text Files. Random Access to Files of Records. Introduction to Command Line Arguments.	25

Text Books:

- Behrouz A. Forouzan and Richard F. Gilberg, "Computer Science – A Structured Programming Approach Using C", C Language Learning, 2007

Reference Books:

- Herbert Schildt, "C: The Complete Reference", 5th Edition, McGraw Hill Education
- K. N. King, "C Programming a Modern Approach", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, "The C Programming Language", PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1, CO4, CO8.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of problem solving skills.
- CO2: Apply the basic principles of programming in C language.
- CO3: Understand the concepts of arrays and strings in C language.
- CO4: Apply the concepts of functions to solve real world problems.
- CO5: Illustrate the concepts of recursion.
- CO6: Understand the concepts of pointers in C language.
- CO7: Understand the basic concepts of file handling.
- CO8: Develop algorithmic solutions to simple computational problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO10/PSO1,PSO3
CO3	PO1,PO2,PO3,PO4/PSO1,PSO3
CO4	PO1,PO3, PO12/PSO1,PSO2
CO5	PO1,PO2,PO4 /PSO1,PSO3
CO6	PO1,PO2,PO3,PO4/PSO1,PSO2
CO7	PO1,PO3,PO6 /PSO1
CO8	PO1,PO2,PO4,PO10,PO12/PSO1,PSO3

BCSC0002: OBJECT ORIENTED PROGRAMMING

OBJECTIVE: *This course introduces the Object-Oriented programming paradigm to students. It also teaches a student how to think objectively and model a Java program for solving real-world problems.*

CREDITS: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Object-Oriented Programming:** Features of Object-Oriented Programming, Introduction to Object-Oriented Java Programming. **g Java Technology & Environment:** Understanding the compilation process of the JVM, JVM vs JDK vs JRE, Key Features of Java, Structure of a simple Java program. **Working with Java Primitive Data Types:** Strongly Typed nature of Java, Primitive Data Types in Java, The new 'var' keyword, Scope of a variable. **Accepting User Input in Java Programs:** using the Scanner class, using command line arguments. **Programming Constructs:** Sequence, Selection, Iteration & Transfer Statements, For-Each Loop. **Working with Java Arrays**: Declaring and Initializing One-Dimensional and Two-Dimensional Arrays in Java, Introduction to java. util. Arrays class. **The String API:** String Data Type, commonly used methods from the String API, StringTokenizer, StringBuilder & StringBuffer. **Creating and Using Methods:** Signature of a method, Types of Methods, Overloading methods in a class, Static and Non-Static Methods. **Describing and Using Objects & Classes:** Declare the structure of a Java class, declaring members of a class (fields and methods), declaring and using Java Objects, lifecycle of an Object (creation, assignment, dereferencing and garbage collection), Constructors of a class, Overloading Constructors, Constructor chaining using 'this' and 'super' keyword. **Using Java Packages:** create and import Java packages and static imports, abstracting program logic to packages, creating executable main class, running the executable class inside a package. **Applying Encapsulation**: Using access modifiers with/in a class, principles of encapsulation. **Programming Abstractly Through Interfaces:** create and implement Interfaces for programs, private and default methods in Interfaces, declaring Abstract Classes, Constructors in Abstract Classes. Marker Interface, Functional Interfaces, Lambda Expressions in Java.	20
II	**Reusing Implementations using Inheritance:** Declaring Subclasses and Superclasses, extend Abstract Classes, implementing Interfaces, exploring polymorphic behaviour by overriding methods, Object Types vs Reference Types, differentiate overloading, overriding and hiding. **Exception Handling:** Exception Hierarchy, Need of Exception Handling, Checked Exceptions, Unchecked Exceptions and Errors, Try-Catch Blocks, Finally, Throw & Throws Keywords, creating and handling Custom Exceptions. **Threads in Java:** Life Cycle of a Thread, creating threads using Runnable and Thread, 'sleep ()', Thread Priorities. **Using Wrapper Classes:** Wrapper Classes in Java, Boxing-Unboxing-Auto Boxing-Auto Unboxing. **Generics & Collections:** Creating Generic classes, Generic Methods, Diamond Notation, Wildcards, Type Erasure, Collection Hierarchy, Base Interfaces, Lists, Sets and Maps. **The Stream API:** Introduction to the Stream API, using lambda expressions in Streams. **Regular Expressions:** Pattern and Matcher Class. **JDBC:** JDBC Drivers, Connecting to a MySQL Database, DriverManager, Connection Interface, Statement Interface, Result Set Interface, Prepared Statements.	18

Text Book:

- Herbert Schildt , “The Complete Reference, Java Eleventh Edition”, Oracle Press, 2019.

Reference Book:

- Cay S Hosrtmann ,“Core Java Volume I—Fundamentals, Eleventh Edition”, Pearson, 2018.
- Rogers Cadenhead ,“Sams Teach Yourself Java in 21 Days (Covers Java 11/12), 8th Edition”, Pearson, 2020.

Focus: This Course focuses on Employability under CO1, CO2, CO5, CO8.

Outcomes: After completion of the course, students will be able to -

- CO1: Understand the basics of Object-Oriented Programming paradigm.
- CO2: Construct the logical flow of programs by using the sequence, selection, iterations and transfer statements.
- CO3: Apply the concepts of Object- Oriented Programming to model programs in Classes, Abstract Classes, Interfaces and Enums, and simplify program function by dissecting it into methods.
- CO4: Understand accessibility of members in a program unit and create packages to prevent namespace collisions.
- CO5: Predict run-time errors in a program by examining program functioning.
- CO6: Show the parallel processing capabilities of a program using a multithreading concept.
- CO7: Experiment with the predefined classes and interfaces defined in the Collections Framework.
- CO8: Develop a program using JDBC connectivity to demonstrate data persistence.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1 /PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/ PSO2
CO7	PO1,PO2,PO11/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO2

BCSC0003: DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database & NoSQL system. Students learn how to design and create a good database.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System Vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with Case Studies. Data Modeling Using the Entity-Relationship Model**:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. Relational Data Model and Language**:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization I:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, Non-Redundant Cover, Canonical Cover. **PL/SQL:** Query languages, nested queries, group by and having clause.	20
II	**Database Design & Normalization II:** 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, MVD and JDs, Inclusion Dependence. **File Organization:** Indexing, Structure of Index files and Types, Dense and Sparse Indexing **Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication.	20

Text Books:

- Elmasri and Navathe , "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010
- Sadalage, P. & Fowler ,"NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. & Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1, CO2, CO6, CO8.

Outcome: After the completion of the course, the student will:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss indexing mechanisms for efficient retrieval of information from a database.
- CO8: Discuss recovery system and be familiar with introduction to web database, distributed databases.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1 /PSO1
CO2	PO2, PO3/ PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3,PO9/ PSO2
CO7	PO1,PO11 /PSO1
CO8	PO1,PO3,PO12/ PSO2

BCSC0004: OPERATING SYSTEMS

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Operating System and its Classification - Batch, Interactive, Multiprogramming, Time sharing, Real Time System, Multiprocessor Systems, Multithreaded Systems, System Protection, System Calls, Reentrant Kernels, Operating System Structure- Layered structure, Monolithic and Microkernel Systems, Operating System Components, Operating System Functions and Services. **Processes:** Process Concept, Process States, Process State Transition Diagram, Process Control Block (PCB), Process Scheduling Concepts, Threads and their management. **Process Synchronization:** Principle of Concurrency, Implementation of concurrency through fork/join and parbegin/parend, Inter Process Communication models, shared memory and message passing Schemes, Producer / Consumer Problem, Critical Section Problem, race condition ,two process software solution Dekker's solution, Peterson's solution, Semaphores, Synchronization Hardware. **Classical Problem in Concurrency:** Dining Philosopher Problem, Readers Writers Problem, sleeping barbar,	20
II	**Deadlock:** System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock, Combined Approach. **Memory Management:** Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation. **Virtual memory concepts:** Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Locality of reference. **I/O Management and Disk Scheduling:** I/O devices, I/O subsystems, I/O buffering, Disk storage and disk scheduling. **File System:** File concept, File organization and access mechanism, File directories, File allocation methods, Free space management.	20

Text Books:

- Silberschatz, Galvin and Gagne ,"Operating Systems Concepts",9th Edition, Wiley, 2012.

Reference Books:

- Sibsankar Halder and Alex a Aravind ,"Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1, CO2, CO3,CO6.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the classification of operating system environment.
- CO2: Understand the basic of process management.
- CO3: Apply the concept of CPU process scheduling for the given scenarios.
- CO4: Illustrate the process synchronization and concurrency process in operating system.
- CO5: Analyze the occurrence of deadlock in operating system.
- CO6: Describe and analyze the memory management and its allocation policies.

- CO7: Understand the concepts of disk scheduling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO4/PSO1,POS3
CO4	PO3,PO4,PO6/PSO3,PSO4
CO5	PO1,PO4/PSO1,PSO3
CO6	PO1,PO2 /PSO1,PSO3
CO7	PO1,PO2,PO7/PSO1,PSO3

BCSC0005: COMPUTER ORGANIZATION

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**PREAMBLE:** Subject Introduction, Basic organization of the computer and block level description of the functional units, Number Representation, Fixed and floating-point Number Representation-Arithmetic Addition/subtraction, overflow, IEEE standard for floating point representation, **Basic Computer Organization and Design:** Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description. Introduction to combinational circuit - Half Adder, Full Adder, carry look ahead adder, Multiplexor/ De multiplexer and Decoder/Encoder, Introduction to sequential circuit- Flip-Flops, Synchronous and Asynchronous Counters, Register, Bus and memory Transfer Language. **Arithmetic Operations:** Addition and subtraction of signed numbers, Hardware implementation of Method, Multiplication: Signed operand multiplication, Booths algorithm, Hardware implementation of Algorithms, Array Multiplier. **Processor Organization:** General register organization, Single Accumulator and Stack organization, Addressing Modes, Types of Computer Instructions – one, two, three & four address, Instruction Cycle, Instruction Formats.	20
II	**Micro-operations:** Arithmetic, Logical & Shift Micro operations with some applications. **Multiprogramming and Multiprocessing:** Introduction to pipelined operation. **Hardwired & Microprogrammed Unit:** Execution of a complete instruction & Branch Instructions, Hardwired control Unit, Micro programmed control Unit, Micro-Instructions, Microinstruction with Next Address field, Pre-Fetching Microinstructions, Concept of Horizontal and Vertical Microprogramming. **Memory:** Basic concept and Hierarchy, RAM memories, 2D, 2 & 1/2D Memory Organization, ROM Memories, Cache Memories: Concept and Design issues performance, Address mapping and Replacement, Auxiliary memories: Magnetic disk, Magnetic tape and Optical disks, Virtual memory: Concept and Implementation. Input/Output: Peripheral Devices, I/O interface, I/O ports. **Interrupts:** Interrupt hardware, Types of Interrupts and Exceptions, Buses, Bus architecture, Types of Buses and Bus Arbitration. Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O, Direct Memory Access, I/O channels and Processors, Standard communication interfaces.	**20**

Text Books:

- M. Mano ,"Computer System Architecture", 3rd Edition, PHI, 1996.

Reference Books:

- D.W. Patterson ,"Computer Organization and Design", 4th **Edition**, Elsevier Publication, 2008
- William Stalling ,"Computer Organization",8th Edition, PHI, 2011.
- V. CarlHamacher, Zaky ,"Computer Organization",4th International Edition, TMH, 1996.
- John P Hays, "Computer Organization", 2nd Edition, TMH.
- Tannenbaum ,"Structured Computer Organization", 5thEdition, PHI, 2005
- P Pal Chaudhry ,"Computer Organization & Design", 2ndEdition, PHI, 2002.

Focus: This Course focuses on Employability under CO1, CO5, CO7.

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the basics of digital computer system.
- CO2: Demonstrate the principle of arithmetic operations on unsigned, signed integers and floating point numbers.
- CO3: Understand the concepts of Combinational and Sequential circuits and their applications.
- CO4: Understand the CPU architecture and organization.
- CO5: Explain the basic concepts of pipelining.
- CO6: Design the steps for the execution of the complete instruction for hardwired and micro-programmed control unit.
- CO7: Explain the function of memory hierarchy.
- CO8: Determine the interface of CPU with input/output devices and their modes of transfer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO1,PO3/PSO1
CO3	PO2,PO3,PO5/PSO2
CO4	PO2,PO3,PO4/PSO1,PSO3
CO5	PO2,PO3,PO4/PSO2
CO6	PO1,PO2,PO3/PSO1,PSO3
CO7	PO2,PO3,PO5/PSO2,PSO3
CO8	PO3,PO4/PSO1

BCSC0006: DATA STRUCTURES AND ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs*.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Terminology, Elementary Data Organization, Properties of an Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic Notations – Big-Oh; Operations on Data Structure, Abstract Data Types (ADT). **Linked Lists:** Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Generalized Linked List, Polynomial Representation and Addition. **Stacks:** Primitive Stack Operations - Push & Pop, Array and Linked Implementation of Stack in C, Application of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of Infix to Postfix expression, Recursion, Principles of Recursion, Tail Recursion, Removal of Recursion, use of stack in Recursion, Tower of Hanoi Problem. **Queues:** Operations on Queue - Add, Delete operations, Implementation of Queue Using Array and Linked List, Circular Queues, Deque and Priority Queue. **Trees:** Basic Terminology, Array Representation and Dynamic Representation; Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Tree Traversal Algorithms - Inorder, Preorder and Postorder; Threaded Binary Trees, Traversing Threaded Binary Trees.	20
II	**Search Trees:** Binary Search Trees (BST), Insertion and Deletion in BST, AVL Trees, Introduction to M-Way Search Trees, B Trees. Threaded binary trees, Priority Queues –Definition and applications, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, and Deletion from a Max Heap. **Searching:** Sequential Search, Binary Search. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Two Way Merge Sort, and Heap Sort. **Graphs:** Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees – Prim's and Kruskal's Algorithm; Shortest Path Algorithm – Bellman-Ford and Dijkstra's Algorithm. **Hashing & Indexing:** Hash Function, Collision Resolution Strategies. Primary Indices, Secondary Indices, Indexing and Hashing Comparisons.	20

Text Book:

- Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein , "Data Structures Using C and C++", 2nd Edition, PHI, 2009.

Reference Books:

- Horowitz and Sahani , "Fundamentals of Data Structures", 3rd Edition, W H Freeman & Co.
- Jean Paul Trembley and Paul G. Sorenson , "An Introduction to Data Structures with Applications", 2nd Edition, TMH, 2007.
- R. Kruse, "Data Structures and Program Design in C" , 2nd Edition, Pearson Education, 2004.
- Lipschutz Schaum's Outline Series , "Data Structures", 12th Reprint, TMH, 2010.
- G A V Pai , "Data Structures and Algorithms", TMH, 2009.

Focus: This Course focuses on Employability under CO1, CO2, CO3,CO7.

Outcome: After completion of course, student will be able to:

- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2
CO3	PO1/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4/PSO3
CO6	PO2/PSO4
CO7	PO2/PSO4

BCSC0007: INTRODUCTION TO MICROPROCESSORS

Objective: *Objective of this subject is to introduce the basic concepts of microprocessor and assembly language programming. Identify and explain the operation of the components of typical microprocessor: the role of the ALU, registers, stack and the use of interrupts.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Microprocessors Evolution and Types, Basics of Pentium Microprocessor, Microprocessor Application, **8-Bit Microprocessor:**8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction Set - Data Transfer Operation, Arithmetic Operation, Logic Operations and Branch Operations; Introduction to Assembly Language Program. **Programming Technique with Additional Instruction**: Looping, Counting, Indexing, Additional Data Transfer and 16-Bit Arithmetic Instruction, Counters and Time Delays, Stack and Subroutine.	20
II	**16 Bit Microprocessor:** Architecture of 8086 – Register Organization, Execution Unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities. **Peripheral Interfacing:** I/O Programming, Programmed I/O, Interrupt Driven I/O, DMA I/O, Memory-Mapped I/Os. **Peripheral Devices:** 8237 DMA Controller, 8255 Programmable Peripheral Interface, 8253/8254 Programmable Timer/Counter, 8259 Programmable Interrupt Controller.	18

Text Books:

- N Senthil Kumar, M Saravanan, and S Jeevananthan , "Microprocessors and Microcontrollers", Oxford University Press India, 2010.

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- Ray A.K. Bhurchandi.K.M , "Advanced Microprocessor and Peripherals", TMH, 2002.
- D. V. Hall , "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.
- Y.C. Liu and G.A. Gibson , "Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design", 2nd Edition, PHI, 2003.

Focus: This Course focuses on Employability under CO1, CO2, CO4,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Demonstrate the Microprocessor internal architecture and its operations.
- CO2: Develop programs based on 8085 microprocessor instruction set and addressing mode.
- CO3: Develop program using looping, counting, indexing, counter and time delays.
- CO4: Understand the concept of stack and subroutine for modular approach.
- CO5: Compare accepted standards and guidelines to select microprocessor (8085 & 8086) to meet performance requirements.
- CO6: Analyze the concept of interfacing the processor to external device with I/O programming & Interrupt Driven I/O.
- CO7: Understand the working of interfacing chips (8237, 8253/54, 8255 & 8259).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1,PSO2
CO3	PO2,PO3/PSO1,PSO2
CO4	PO1,PO2,PO3/PSO1,PSO3
CO5	PO2,PO3,PO5/PSO1,PSO3
CO6	PO1,PO2/PSO3
CO7	PO1,PO2,PO4/PSO3

BCSC 0008: Computer Networks

Objective: *The objective is to understand fundamental underlying principles of computer networking, details and functionality of layered network architecture.*

Credits: 03 **Semester - IV** **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Network Software:** Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Services, Service Primitives, The Relationship of Services to Protocols. Reference Models: The OSI Reference Model, The TCP/IP Reference Model. Example Networks: The Internet, Connection-Oriented Networks (X.25, Frame Relay & ATM), Ethernet. **Introduction Concepts**: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design, Physical Layer Transmission Media, Line coding scheme, switching methods (circuit switching, Packet switching), TDM. **Medium Access sub layer**: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols, CSMA, CSMA/CD, Overview of IEEE standards.	20
II	**Data Link Layer**: Error detection and correction, Flow control (sliding window protocol) **Network Layer**: Network Layer –IP addressing, subnet, CIDR, VLSM, Internetworking, Address mapping, routing. Connecting devices. **Transport Layer**: Transport Layer - Design issues, connection management, Flow control, TCP window management, congestion control-slow start algorithm. **Application Layer**: Data compression, Data Encryption, File Transfer, DNS, HTTP, SMTP, TELNET **Introduction to IPv6, transition from IPv4 to IPv6.**	20

Text Books:

- Forouzan B. A. , "Data Communication and Networking", 4th Edition, McGrawHill, 2004.

References:

- Kurose, J.F. and Ross K.W , "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Addison-Wesley, 2005.
- A.S. Tanenbaum , "Computer Networks", 2nd Edition, Prentice Hall India, 2006.

Focus: This Course focuses on Employability under CO1, CO2, CO4,CO5.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the concept of OSI and TCP/IP reference model.
- CO2: Understand the basics of data transmission at physical layer.
- CO3: Understand the channel allocation using ALOHA, CSMA and CSMA/CD.
- CO4: Apply error detection and correction technique to eliminate transmission error.
- CO5: Analyze the fixed and variable length address (IPv4) subneting for the given scenarios.
- CO6: Understand the design issues of the transport layer.
- CO7: Understand the mechanism of protocols at application layer such as FTP, HTTP, Telnet, DNS.
- CO8: Understand IPv6 addressing and differentiate it from IPv4.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs

CO1	PO1,PO3,PO12/PSO1
CO2	PO1/PSO2
CO3	PO1,PO4/PSO1,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO4,PO6/PSO3
CO6	PO2,PO4/PSO1
CO7	PO5,PO12/PSO2
CO8	PO4,PO7/PSO4

BCSC0009: SOFTWARE ENGINEERING

Objective: *Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility.*

L–T–P-J: 3–0–0-0

Credits: 03

Module No.	Content	Teaching Hours
I	**Introductory Concepts**: The evolving role of software – characteristics, components and applications. **A Generic view of process:** Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. **Process Models:** Waterfall Model, Prototyping, Incremental, Spiral. **Agile software Development**: Introduction to Agile, Agile software development framework. **Software Requirement Specification**: Requirement Process, SRS Components, Requirement Specifications with Use Cases Diagram. **Software Project Planning:** Project Planning Objectives. **Software Metrics:** Size, Function Point, Staffing, Project Estimation Methods–COCOMO Model. **Function-Oriented Design**: Problem Partitioning, Abstraction, Top Down and Bottom Up Design. **Module-Level Concepts:** Coupling, Cohesion, Design Notation and Specification - Structure Charts; Structured Design Methodology - Data Flow Diagram, Sequence Diagram.	20
II	**OO Analysis and OO Design:** OO Concepts, Introduction to UML Design Patterns: Class Diagram, Activity Diagram, State Chart Diagram. **Coding**: Coding Process, Verification – Code Inspections, Software Metrics. **Testing Fundamentals**: Test Case Design, Black Box Testing Strategies, White Box Testing, Unit Testing, Integration Testing, System Testing. **Introduction to Automation Testing and Testing Tools:** Automated Testing Process, Framework for Automation Testing, Introduction to Automation Testing Tool. **Software Quality:** Models, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model. **Software Maintenance**: Models Cost of Maintenance, Re-engineering, Reverse Engineering.	18

Text Books:

- R. S. Pressman , "Software Engineering: A Practitioners Approach", 7thEdition, McGraw Hill, 2010.

Reference Books:

- K. K. Aggarwal and Yogesh Singh , "Software Engineering", 3rd Edition, New Age International Publishers, 2008.
- Rajib Mall , "Fundamentals of Software Engineering", 3rd Edition, PHI Publication, 2009.
- R.E Fairley , "Software Engineering", McGraw Hill, 2004.
- Sommerville , "Software Engineering", 9th Edition, Pearson Education, 2010.

Focus: This Course focuses on Employability under CO1, CO2, CO4.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of software engineering.
- CO2: Apply software processes to solve real world problems.
- CO3: Estimate the cost, effort and schedule of software using COCOMO Model.
- CO4: Analyze the software design techniques (structure chart, SDM, sequence diagram).

- CO5: Understand the basic concepts of OO analysis and design.
- CO6: Develop the test cases to validate the software.
- CO7: Understand the basic models of software Quality and maintenance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7/PSO1
CO2	PO2,PO3/PSO4
CO3	PO2,PO11/PSO3
CO4	PO3,PO10/PSO4
CO5	PO3,PO7/PSO1
CO6	PO5,PO12/PSO2
CO7	PO4,PO9,PO12/PSO1

BCSC0010: DISCRETE MATHEMATICS

Objective: *The objective is to introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in computer science.*

Credits: 4 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Sets, Relations and Functions:** Introduction to Set Theory, Venn diagrams, algebra of Sets, Inclusion-Exclusion Principle, Partitions, Proof Techniques, Relations, Properties and their types, Function and their types. Recurrence Relations and Generating Functions **Introduction to Counting Principle**: Permutation, Combination, Permutation with Repetition, Combination with Repetition, Pigeonhole Principle. **Probability Theory**: Introduction to Probability Theory, Conditional Probability, Total Probability, Bayes' Theorem.	20
II	**Propositional Logic -** Logical Connectives, Truth Tables, Normal Forms (Conjunctive and Disjunctive), Validity; **Predicate Logic -** Quantifiers, Inference Theory, Methods of Proof: Direct, Indirect, Mathematical Induction. **Algebra**: Motivation of Algebraic Structures, Finite Groups, Subgroups and Group Homomorphism; Lagrange's Theorem; Commutative Rings and Elementary Properties; **Graph Theory:** Introduction to Graphs, Types: Planner, Directed, Complete, Bipartite Graph, Isomorphism , Euler Graph, Hamiltonian Graph, Operations on Graphs, Representation of graphs, Connectivity.	20

Text Book:

- Kenneth H Rosen ,"Discrete Mathematics and Its Applications", 7th edition, TMH, 2012.

Reference Books:

- J.P. Tremblay , "Discrete Mathematical Structures with Applications to Computer Science", TMH, New Delhi, 1997.
- V. Krishnamurthy), "Combinatorics: Theory and Applications", East-West Press, New Delhi, 1986.
- Ralph P. Grimaldi , "Discrete and Combinatorial Mathematics- An Applied Introduction", 5th Edition, Pearson Education, 2004.
- C.L. Liu , "Elements of Discrete Mathematics", 2nd Edition, TMH, 2000.

Focus: This Course focuses on Employability under CO1, CO2, CO3,CO5,CO8.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the notion of mathematical thinking and proofs to solve the problem.
- CO2: Apply the basics of discrete probability and number theory to solve the real world problem. CO3: Analyze basic discrete structures and algorithms using effectively algebraic techniques.
- CO4: Analyze mathematical concepts like sets, reasoning, relational algebra and graph theory to solve optimization problems.
- CO5. Analyze the validity of an argument using logical notation.
- CO6. Demonstrate the basic structures of proof techniques to write and evaluate the validity of arguments.
- CO7. Understand the basic principles of sets, set equalities and operations in sets.
- CO8. Apply counting principles to determine probabilities.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO3
CO2	PO1,PO3/PSO4
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3
CO5	PO1,PO2/ PSO3
CO6	PO1,PO3/PSO2,PSO3
CO7	PO1,PO2/PSO1
CO8	PO1,PO3/PSO1,PSO4

BCSC0011: THEORY OF AUTOMATA & FORMAL LANGUAGES

Objective: *The objective of this course is that students will study and compare different models and views of the abstract notion of computation and its various aspects.*

Credits:04 **Semester V** **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem; FA with Output - Moore and Mealy machine, Applications and Limitations of FA. **Regular expression (RE):** Regular Expression to FA, DFA to Regular Expression, Arden Theorem, Non Regular Languages, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages. **Push Down Automata (PDA):** Introduction, Language of PDA, Acceptance by Final State, Acceptance by Empty Stack, Deterministic PDA.	20
II	**Context Free Grammar (CFG) and Context Free Languages (CFL):** Introduction, Derivation Trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Simplification of CFGs, Normal Forms for CFGs - CNF and GNF; Pumping lemma for CFLs, Equivalence of PDA and CFG. **Turing machines (TM):** Basic Model, Definition and Representation, Variants of Turing Machine and their equivalence, TM for Computing Integer Functions, Universal TM, Church's Thesis, Recursive and Recursively Enumerable Languages, Halting Problem, Introduction to Computational Complexity. **Decidability:** Post's Correspondence Problem (PCP), Rice's Theorem, Decidability of Membership, Emptiness and Equivalence Problems of Languages.	20

Text Books:

- K.L.P. Mishra and N. Chandrasekaran , "Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI, 2006.

Reference Books:

- Hopcroft, Ullman , "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2013.
- Martin J. C ," Introduction to Languages and Theory of Computations", 4th Edition, TMH, 2011.

Focus: This Course focuses on Employability under CO1, CO2, CO5,CO6.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of Context Free languages, Expression and Grammars.
- CO2: Analyze the conversion of NFA to DFA, Mealy to Moore and Moore to Mealy.
- CO3: Analyze the process to convert regular expression to DFA, DFA to regular expression, and minimization of DFA.
- CO4: Develop the PDA for the context free language and context free grammar.
- CO5: Analyze that the grammar is ambiguous or unambiguous.
- CO6: Apply the process to convert CFG to CNF and GNF.
- CO7: Understand the concept of Turing machine and its variants.

- CO8: Design the Turing machine for the real world application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO4
CO2	PO2,PO3/PSO3
CO3	PO2,PO3,PO9,PO12/PSO1,PSO3,PSO4
CO4	PO1,PO3,PO5,PO9/PSO3,PSO4
CO5	PO1,PO2,PO4/PSO3
CO6	PO2,PO3/PSO3
CO7	PO1,PO2/PSO1,PSO3
CO8	PO3,PO12/PSO1,PSO2,PSO3

BCSC0012: DESIGN & ANALYSIS OF ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and concepts including Trees, Recursion & Dynamic programing.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Algorithms, analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Sorting and order Statistics - Shell sort, Quick sort, Merge sort, Heap sort, Comparison of sorting algorithms, Sorting in linear time. **Advanced Data Structures:** Red-Black trees, B – trees, Binomial Heaps, Fibonacci Heaps. Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching.	20
II	Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets Dynamic programming with examples such as Knapsack. All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem	20

Text Books:

- Thomas H. Coremen, Charles E. Leiserson and Ronald L. Rivest , Introduction to Algorithms, Third edition, Prentice Hall of India, 2008.

Reference Books:

- Gilles Brassard Paul Bratley , " Fundamentals of Algorithms", Prentice Hall, 1996.
- Ellis Horowitz, SartajSahni, SanguthevarRajasekaran , "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd, 2008.
- Levitin , "An Introduction to Design and Analysis of Algorithms", Pearson, 2008.

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of course, student will be able to:

- CO1: Understanding of complexity representation in terms of Big Oh, Theta and Omega notations.
- CO2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms (quick sort and merge sort).
- CO3: Compare and analyze different data structures (RB Tree, B Tree, Binomial Heaps, Fibonacci Heaps).
- CO4: Understand the major graph algorithms (DFS, BFS, Dijkstra's Bellman Ford) and their analyses.
- CO5: Understand the greedy paradigm and able to analyze when an algorithmic design situation calls for it. Synthesize greedy algorithms (Optimal Reliability Allocation, Minimum Spanning Trees, factorial Knapsack) and analyze them.

- CO6: Synthesize dynamic-programming algorithms (0/1 knapsack problem, Resource allocation problem, Warshal's and Floyd's algorithms) and analyze them.
- CO7: Understand the backtracking paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize backtracking algorithms (N Queen Problem, TSP Problem, sum of subsets problem, Graph Coloring) and analyze them.
- CO8: Understand the branch and bound paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize branch and bound algorithms (N Queen Problem, TSP Problem, Hamiltonian Cycles, Graph Coloring) and analyze them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4,PO12/PSO1,PSO3
CO2	PO1, PO3,PO4,PO5/PSO1,PSO3
CO3	PO1,PO3, PO6/PSO1,PSO3
CO4	PO1,PO2,PO3, /PSO1,PSO3
CO5	PO1,PO2 /PSO1,PSO3
CO6	PO1,PO2,PO3, PO6/PSO1,PSO3
CO7	PO1,,PO4,PO12/PSO1,PSO3
CO8	PO1,PO2,PO3,PO4,PO12/PSO1,PSO2

BCSC0606: INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Objective: *The objective of the course is to understand the importance of artificial intelligence, gain knowledge on the basis of AI,and understand the role of AI in solving societal problem.*

Credits: 03 **Semester II** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Basics of AI:** History and definitions of AI, Characteristics of AI, Emergence of AI Applications of AI, Logical approach to AI and knowledge based system **Probabilistic approach of AI :**Basic Concepts, Probability of events, Counting rules, Event relations, Conditional Probability, Bayes' rule **Neural Networks:** Introduction, Appropriate problems of neural network learning, A single neuron, Activation Functions, Feed forward NN, Back Propagation and Weights update. **Evolutionary Intelligence:** Biological background-The cell, Chromosomes, genes, genomes, Reproduction, Natural Selection, Introduction of Genetic algorithm: Population Selection, Cross over, Mutation.	20
II	**Introduction to Machine Learning:** Motivation for ML, Learning associations, Ml process, Steps to apply machine learning to data, Input data and ML algorithms, Classification of ML algorithms, General ML architecture, Types of machine learning. **Learning Deterministic models :**Regression, Linear regression with examples, Multiple linear regression, Supervised learning: Logistic Regression, K nearest neighbor, Unsupervised Learning: K- mean clustering **Introduction to Python :** Use of ML with python	20

Text Books:

- Introduction to Artificial Intelligence & Machine Learning, Innovation center for education IBM .

References:

- Mitchell, T.M. "Machine Learning" , McGraw-Hill
- Buchanan , Bruce G.A. "Brief History of Artificial Intelligence", AI Magazine

Focus: This Course focuses on Employability under CO1, CO2, CO5.

Outcome : After completion of this course, student will be able to:
- CO1: Apply the basic concepts of machine learning including bias-variance tradeoff, sample and true error.
- CO2: Apply the concepts of regression.

- CO3: Apply the techniques to reduce size of dataset by using feature selection and feature extraction for proper machine learning.
- CO4: Formulate the ensemble methods for improving classification.
- CO5: Design use of ANN with optimization in machine learning.
- CO6: Design and develop projects based on machine learning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3/PSO1,PSO3
CO2	PO2,PO3/ PSO3
CO3	PO2/PSO1,PSO3
CO4	PO2,PO3/PSO4
CO5	PO3,PO4/PSO2,PSO4
CO6	PO1,PO3/PSO2,PSO4

BCSG0800: PYTHON PROGRAMMING LAB

Objective: *This course introduces the solving of problems using Python programming using OO concepts and its connectivity with database.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	Programs based on the concepts of: • Building Python Modules • Obtaining user Data • Printing desired output Programs based on the concepts of: • Conditional if statements • Nested if statements • Using else if and elif Programs based on the concepts of Iteration using different kinds of loops Usage of Data Structures • Strings • Lists • Tuples • Sets • Dictionary Program based on the concepts of User-defined modules and Standard Library (random, numpy, scipy, sys, Math Module, String Module, List Module). Program based on Input Output. Program based on exception Handling. Program based on Simple Data analysis. Program based on Pandas.	26

Text Books:

- Paul Barry: “Head First Python “O’Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: “Effective Python: 59 Specific ways to write better Python”, Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: By the end of the course, students will learn to:

- CO1: Apply OO concepts using Python programming.
- CO2: Apply in-built packages defined in Python.
- CO3: Apply front-end as Python Programming to connect with any back-end.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO4
CO3	PO5/PSO2

BCSC0800: COMPUTER PROGRAMMING LAB

Objective: *The objective is to provide a comprehensive study of the C programming language. It stress the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours

I & II	• Mapping of flow chart, Algorithm, Language
	• Simple C-program execution
	• Programs based on various operators
	• Programs based on Decision and case Control Structure
	• Programs based on Loop Control Structure
	• Program based on special control statement
	  ➢ break
	  ➢ continue
	• Programs based on Array Insertion, Deletion, Linear Search & Bubble Sort
	• Programs based on String
	  ➢ Length, Copy, Reverse, Concatenate, Compare with & without built-in functions
	• Programs based on Functions.
	• Programs based on Storage Class.
	• Programs based on Recursion.
	• Programs based on Preprocessor.
	• Programs based on Pointers
	• Programs based on array
	• Programs based on string
	• Programs based on call by value and call by reference
	• Programs based on Dynamic Memory Allocation
	• Programs based on User Defined Data types
	  ➢ Structure and Union
	  ➢ Enum and Typedef
	• Programs based on File handling
	  ➢ Opening a file
	  ➢ Reading, writing and appending a file
	  ➢ Closing file
	  ➢ Random Access to Files of Records
	• Programs based on Command Line Argument.
		52

Reference Books:

- Herbert Schildt, “C: The Complete Reference”, 5th Edition, McGraw Hill Education.
- K. N. King, “C Programming a Modern Approach”, W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, “The C Programming Language”, PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, “Programming in C”, Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: On Completion of this course, students are able to:

- CO1: Design programs involving decision structures, loops and functions.
- CO2: Understand the concepts of functions, recursion, pointers and file handling.
- CO3: Design programs involving structures, union and functions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO3,PO4/PSO1
CO3	PO3/PSO2,PSO4

BCSC0801: OBJECT ORIENTED PROGRAMMING LAB

Objective: *The objective of this course is that students will study and learn Object Oriented Modeling and programming.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	Programs in Java and python based on the concepts of: • Classes, Constructors, Polymorphism and Keyword Static. Programs based on the concepts of: • Inheritance, Multithreading Using Thread Class & Interface Runnable, String Handling, Generic Classes. Programs based on the concepts of: • Handling Database Connectivity. • Implementation of Collection Framework. Programs based on the concepts of: • Database Connectivity. • Retrieving Data from Database. • Parameters Passing, Execute many Method. • Cursor Attributes. • Invoke Stored Procedures. • Invoke Stored Functions.	24

Reference Books:

- Naughton, Schildt , "The Complete Reference JAVA2", 9th Edition, Oracle Press.
- Bhave & Patekar , "Programming with Java", Pearson Education
- Bret Slatkin , "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Implement object oriented language features.
- CO2: Design GUIs and Graphical programming.
- CO3: Design object oriented solutions for small systems involving database and event handling concepts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO5/PSO2
CO3	PO3,PO5/PSO4

BCSC0802: DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Generation of database report,.	24

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, "Database Management System", TMH

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Develop the SQL queries for real life scenarios.
- CO3: Implement the procedural language (PL/SQL) and Triggers.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO1,PO2/PSO1,PSO4
CO3	PO2,PO3,PO5/PSO2,PSO3

BCSC0803: OPERATING SYSTEMS LAB

Objective: *The lab aims to develop understanding the operation of UNIX operating system.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implement the following basic commands (with options) used in UNIX/LINUX OS. • Write and implement the basic vi editor commands. • Shell scripts that use simple commands. • Decision based Shell scripts. • Shell scripts related to strings. • Shell scripts using pipes. • Shell scripts with loop statements. • Demonstration and solution for race condition. • Demonstration and use of System Calls. • Implement the basics of IPC in UNIX. • Implementation of Classical Problem in Concurrency	24

Reference Books:

- SibsankarHalder and Alex a Aravind , " Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Implement the basic operations on UNIX operating systems.
- CO2: Demonstrate the working of systems calls.
- CO3: Demonstrate message passing in Unix operating system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO4,PO5/PSO1,PSO2

BCSC0804: COMPUTER ORGANIZATION LAB

Objective: *The aim of the lab is to better understand the design of sequential Circuits such as Flip-Flops, Registers, and Counters.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• Bread Board Implementation of Flip-Flops. • Experiments with clocked Flip-Flops. • Design of Counters. • Bread Board implementation of Counters &Shift Registers. • Implementation of Arithmetic Algorithms. • Bread Board implementation of Adder/Subtraction (Half, Full). • Bread Board implementation of Binary Adder. • Bread Board implementation of Seven Segment Display. • Small Project based on combinational and sequential circuit. • Verify the excitation tables of various FLIP-FLOPS . • Design of an 8-bit ARITHMETIC LOGIC UNIT. • Design of 24x8 (16 byte) RAM. • Design of 24x8 (16 byte) STACK. . Implementation of a 4-bit PROCESSOR.	24

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4th **Edition**, Elsevier Publication, 2008.
- William Stalling , "Computer Organization",8th Edition, PHI, 2011.
- M. Mano, "Computer System Architecture", 3rd Edition, PHI, 1996

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Implement the Combinational and Sequential Circuit.
- CO2: Demonstrate the working of counter and shift register.
- CO3: Demonstrate the working of ALU and seven segment displays.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO5/PSO2
CO2	PO3,PO4/PSO2
CO3	PO3,PO5/PSO1,PSO2

BCSC0805: DATA STRUCTURES & ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module		Lab
I &II	• Program to implement various operations in a singly linked list. • Program to implement insertion, deletion and traversal in a doubly linked List. • Program to implement polynomial addition using linked list. • Program to demonstrate the various operations on stack. • Program to convert an infix expression into postfix expression. • Program to evaluate a given postfix expression. • Program to implement Tower of Hanoi problem using Recursion. • Program to demonstrate the implementation of various operations on linear and circular queue. • Program to demonstrate the implementation of insertion and traversals on a binary search tree. • Program to implement Dijkstra's Algorithm to find the shortest path between source and destination. • Program to search a given element as entered by the user using sequential and binary search to search a given element as entered by the user. • Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort. • To write the following recursive functions for a singly-linked NULL-terminated list: insert(), traverse(), search().	24

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3

CO3	PO2/PSO3,PSO4

BCSC0806: MICROPROCESSORS LAB

Objective: *The objective is to introduce the Architecture and programming of the microprocessor and learning about interfacing and various applications of microprocessor.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• To study 8085 microprocessor System. • To study 8086 microprocessor System. • To develop and run basic programs in 8085 ALP. • To develop and run programs in 8085 ALP related to the concept of looping, counting and indexing. • To perform interfacing of RAM chip to 8085/8086. • To perform interfacing of keyboard controller. • To perform interfacing of DMA controller. • To perform interfacing of UART/USART.	24

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- D. V. Hall , "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the arithmetic and logical operations using assembly language programming (8085).
- CO2: Demonstrate the memory operations using assembly language programming (8085).
- CO3: Demonstrate the interfacing of Keyboard, DMA and UART controller.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO2/PSO1,PSO2
CO3	PO1,PO3,PO5/ PSO2

BCSC0807: DESIGN & ANALYSIS OF ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implementation of sorting algorithms: ○ Insertion Sort ○ Bubble Sort ○ Selection Sort ○ Divide and conquer approach: • Quick Sort • Merge Sort ○ Heap Sort ○ Counting Sort • Implementation of Searching Techniques: ○ Linear Search ○ Binary Search • Implementation of Matrix Multiplication • Implementation of Convex Hull • Implementation of Breadth First Search • Implementation of Depth First Search • Implementation of Greedy approaches: ○ Optimal Reliability Allocation. ○ Knapsack. Minimum ○ Minimum Spanning trees: • Prim's and Kruskal's algorithms. ○ Single source shortest paths – • Dijkstra's and Bellman Ford algorithms. • Implementation of Dynamic Programming: ○ Longest Increasing Subsequence. ○ Finding best path in maze. ○ Matrix Chain Multiplication ○ 0/1 Knapsack Problem ○ Resource Allocation Problem	32

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of course, student will be able to:

- CO1: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.
- CO2: Demonstrate and use the appropriate data structures for a given problem
- CO3: Implement the algorithms based on Greedy approach and Dynamic Programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO1,PSO2,PSO4
CO2	PO1,PO3,PO4/PSO1,PSO2,PSO3

CO3	PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0014: APPLIED DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database& NoSQL system. Students learn how to design and create a good database.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with case studies. **Data Modeling Using the Entity-Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. **Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, Non Redundant Cover, Canonical Cover, MVD and JDs, Inclusion Dependence.	26
II	**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication. **NoSQL System:** RDBMS vs NoSQL, BASE properties, Key-value, Columnar, Document and Graph-Based database, Introduction of MongoDB, Cassandra, Neo4j and Riak. **Database Programming using Python**: Database connectivity, Retrieving Data from Database, Parameters Passing, Executemany Methods, Cursor Attributes, Invoke Stored Procedures, Invoke Stored Functions.	26

Text Books:

- Elmasri and Navathe , "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. &Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1, CO2, CO5,CO8.

Outcome: After completion of course, student will be able to:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.

- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss recovery system and be familiar with introduction to web database, distributed databases.
- CO8: Explain the differences between RDBMS and No-SQL,BASE properties and No-SQL databases.
- CO9: Design and implement the database system with the fundamental concepts of DBMS using Python.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2,PO3/PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3/PSO2
CO7	PO1,PO3/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO4
CO9	PO1,PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0808: APPLIED DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL and NoSQL databases.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Introduction to MongoDB and its Installation on Windows or Linux, Description of mongo Shell, create database and show database, Commands for MongoDB and To study operations in MongoDB – Insert, Query, Update, Delete and Projection • To implement Database connectivity using Python	24

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, "Database Management System", TMH
- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Implement the procedural language (PL/SQL) and Triggers.
- CO3: Apply NoSQL queries in MongoDB.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO2,PO3,PO5/PSO2,PSO3
CO3	PO5/PSO2

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Specialization In Artificial Intelligence And Machine Learning									
THEORY									
1.	BCSE0701	Introduction To Machine Learning	3	0	0	0	3	3	
2.	BCSE0702	Algorithm for Intelligent Systems and Robotics	2	0	0	0	2	2	
3.	BCSE0703	Data mining & Predictive Modeling	2	0	0	0	2	2	
4.	BCSE0704	Computational Linguistics and Natural Language Processing	2	0	0	0	2	2	
5.	BCSE0705	Application of Machine Learning in industries	2	0	0	0	2	2	
6.	BCSE0706	Neural Networks	3	0	0	0	3	3	
7.	BCSE0707	Cognitive Analytics	2	0	0	0	2	2	
8.	BCSE0708	Pattern and Anomaly Detection	3	0	0	0	3	3	
PRACTICALS									
1.	BCSE0731	Introduction To Machine Learning Lab	0	0	2	0	1	2	
2,	BCSE0732	Algorithm for Intelligent Systems and Robotics Lab	0	0	2	0	1	2	
3.	BCSE0733	Data mining & Predictive Modeling Lab	0	0	2	0	1	2	
4.	BCSE0734	Computational Linguistic and Natural Language Processing Lab	0	0	2	0	1	2	
5.	BCSE0735	Application of Machine Learning in Industries Lab	0	0	2	0	1	2	
6.	BCSE0736	Neural Networks Lab	0	0	2	0	1	2	
15.	BCSE0737	Cognitive Analytics Lab	0	0	2	0	1	2	
16.	BCSE0738	Pattern and Anomaly Detection Lab	0	0	2	0	1	2	
Total			**19**	**0**	**16**	**0**	**27**	**35**	

BCSE0701: INTRODUCTION TO MACHINE LEARNING

Objective: *The objective of this course to introduce basis process of machine learning, mathematical modeling of the supervised and unsupervised machine learning methods and to utilize combined voting of the different machine learning methods for solving real-world problems using machine learning. approach.*

L-T-P-J:0-0-2-0

Credits: 03

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to machine learning, Applications, and motivation, programming approach vs. machine learning approach in Artificial Intelligence, components of a learning problem (such as data, model, and error functions), basic learner, types of learning, features and feature vector, process of learning (training), testing, bias and variance error. **Python for Data Science-**Numpy, Pandas for preprocessing, Matplotlib and Jupyter Notebook. **Data Preprocessing-** Importing the Libraries, Importing the dataset, data imputation, Encoding Categorical Data, Splitting the dataset into Training and Test set, Feature Scaling. **Forecasting and Learning Theory:** Predicting numerical values: linear and non-linear regression. (Implementation on any real-world dataset e.g. Boston Housing), Regression model using Gradient Descendent. **Validation:** True and sample error, over-fitting, role of cross validation, regularization, bias-variance analysis. **Performance-Measures:** Types-of-errors, accuracy, confusion-matrix, precision-recall. **Project:** Estimation of diabeties using regression with gradient descendent.	21
II	**Dimensionality Reduction:** Feature Selection vs. feature extraction, Principal Component Analysis (PCA), Singular Value Decomposition. **Supervised Learning:** support vector machine, decision tree, Naïve Bayes classifier. **Unsupervised Learning:** clustering, Hierarchical clustering **Ensemble Learning**: Introduction, Bagging, Boosting, Improving classification, Ada-Boost algorithm. **Machine learning Approach in NLP-** Introduction to NLP libraries e.g. spacy, NLTK. Text classification using spacy, sentiment classification using spacy on IMDB dataset. **Introduction of CNN-** Difference between ANN and CNN, libraries to implement CNN and designing an application of image processing using CNN.	21

Text Books:

- Alpaydin, E. . Introduction to machine learning. MIT press, 2009.
- Bishop, C. M. . Pattern recognition and machine learning (information science and statistics) springer-verlag new york. Inc. Secaucus, NJ, USA, 2006.

Reference Books:

- Harrington, P. . Machine learning in action. Shelter Island, NY: Manning Publications Co , 2012.

Focus: This Course focuses on Employability under CO1, CO2, CO5.

Outcome: After completion of Lab, student will be able to:

- CO1: Apply the basic concepts of machine learning including bias-variance tradeoff.
- CO2: Apply the concepts of regression.
- CO3: Conceptualize supervise and re-enforcement learning for classification.
- CO4: Formulate the ensemble methods for improving classification.
- CO5: Apply ANN with optimization in machine learning.
- CO6: Design and develop projects based on machine learning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2,PO3/PSO1
CO3	PO4/PSO1,PSO3
CO4	PO2,PO3/PSO4
CO5	PO2,PO4/PSO4
CO6	PO1/PSO2,PSO4

BCSE0731: MACHINE LEARNING LAB

Credits: 02 **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I & II	• Introduction to python, numpy and pandas • Implementation of Simple linear regression • Implementation of Multiple linear regression • Implementation of logistic regression • Implementation of regression models with regularization • Implementation of dimensionality reduction using PCA • Implementation of SVM • Implementation of Decision tree on real word data set • Implementation of Naïve Bayes Classifier • Implementation of k-means clustering • Implementation of ANN	20

Text Book:

- Alpaydin, E., “. Introduction to machine learning”, MIT press, 2009.
- Bishop, C. M. ,”Pattern recognition and machine learning” , (information science and statistics) springer-verlag new york. Inc. Secaucus, NJ, USA, 2006.

Reference Books:

- Harrington, P., “ Machine learning in action. Shelter Island” , NY: Manning Publications Co., 2012.

Focus: This Course focuses on Employability under CO1, CO2, CO3,CO4.

Outcome: After completion of Lab, student will be able to:

- CO1: Implement the basic concepts of machine learning including bias-variance tradeoff.
- CO2: Analyze data using regression and re-sampling methods.
- CO3: Perform supervise learning for classification.
- CO4: Apply and perform dimensionality reduction.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3
CO2	PO2,PO3/PSO1,PSO3
CO3	PO1,PO4/PSO3,PSO4
CO4	PO4/PSO1,PSO3

BCSE0702: INTELIGENT SYSTEM AND ROBOTICS

Objective:

Credits: 02 **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I	**Intelligent Systems and Control:** Introduction to Artificial Intelligence - Introduction to AI, Intelligent agents, Problem Solving by Searching. **Heuristic Search:** best-first search, the A* algorithm.Trade-off between search complexity and heuristic complexity, Simulated Annealing. **Expert System**: General rule bas expert systems (structure, characteristics, chaining inferences, conflict resolution) **Evolutionary Algorithm:** Particle Swarm optimization (PSO) **Uncertainty:** Basic Probability notion, The Axiom's of probability, Bayes' Rule & its use, Probabilistic reasoning (Bayesian Networks).	21
II	**Simulation and control of dynamics systems:**(Simulation of Inverse Pendulum Optimization using GEKKO) **Introduction and Implementation of CNN**: (Development of Image Processing based Application) **Data Augmentation:** Need for data augmentation A. Operations in data augmentation B. Data augmentation in Kera's C. Data augmentation using Augmenter **Case Study**: Implementation of AR, VR in any Image based Application.	21

Text Book:

- Stuart Russell, Peter Norvig , "Artificial Intelligence – A Modern Approach", Pearson, 2009.
- Elaine Rich & Kevin Knight , "Artificial Intelligence", TMH, 2nd Edition, 1999.

Reference Books:

- ZM Zurada, "Introduction to Artificial Neural Systems", West Publishing Company

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of Theory, student will be able to:

- CO1: Describe the attributes of various search techniques and the situations to which they are well-suited.
- CO2: Understand a range of techniques of intelligent systems across artificial intelligence (AI) and intelligent agents (IA); both from a theoretical and a practical perspective.
- CO3: Describe and apply various techniques for logic programming and machine learning.
- CO4: Understand the Theoretical aspect of various tools for the implementation of Robotics.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PSO1,PSO2

CO2	PO1,PO3,PO5/PSO3
CO3	PO2,PO2/PSO4
CO4	PO1,PO2,PO3/PSO1,PSO3

BCSE0732: INTELIGENT SYSTEM AND ROBOTICS LAB

Objective:

Credits: 02 **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I	• Exercise 1: Time Domain and Frequency Domain representation using Python. • Exercise 2: Pendulum Simulation using Python. • Exercise 3: 8 Queen Problem using Python. • Exercise 4: Search Algorithms using Python. • Exercise 5: Hill Climbing using Python. • Exercise 6: Reinforcement learning using python.	12
II	• Exercise 7: Simple Neural Network Concept using Python. • Exercise 8: Kalman Filter using Python. • Exercise 9: Installing ROS and other packages. • Exercise 10: Testing the simulator. • Exercise 11: Teleoperating the simulated Robots. • Exercise 12:Speech Related Experiment.	12

Text Book:

- Stuart Russell, Peter Norvig , "Artificial Intelligence – A Modern Approach", Pearson, 2009.
- Elaine Rich & Kevin Knight , "Artificial Intelligence", TMH, 2nd Edition, 1999.

Reference Books:

- ZM Zurada, "Introduction to Artificial Neural Systems", West Publishing Company

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of Lab, student will be able to:

- CO1: Understand the Practical aspects of various searching strategies to solve AI Problems.
- CO2:Understand a range of techniques of intelligent systems across artificial intelligence (AI) and intelligent agents (IA); both from a theoretical and a practical perspective.
- CO3:Describe and apply various techniques for logic programming and machine learning.
- CO4: Understand the practical aspect of various tools for the implementation of Robotics.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PSO1,PSO3
CO2	PO2,PO2/PSO4
CO3	PO1,PO2,PO3/PSO1,PSO2
CO4	PO1,PO2,PO3/PSO1

GLA University, Mathura (U.P.)

Institute of Engineering and Technology

Department of Computer Engineering & Applications (CEA)

Course: BCA

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Program Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals or entrepreneurs, for developing sustainable solutions.
PEO2: Attain positions of leadership in an organization and /or on teams.
PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Program Specific Outcomes (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.
PSO2: Design and develop application interfaces along with latest tools and technology to meet the needs of industry.
PSO3: Analyze the algorithmic principles, theory of computation for the modeling and design of computing systems.
PSO4: Apply knowledge to provide solutions to existing problems.

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Program Outcomes (POs)

PO1: Computational Knowledge: Apply knowledge of computing fundamentals, computing specialisation, mathematics, and domain knowledge appropriate for the computing specialisation to the abstraction and conceptualisation of computing models from defined problems and requirements.

PO2: Problem Analysis: Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

PO3: Design /Development of Solutions: Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO4: Conduct Investigations of Complex Computing Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

PO6: Professional Ethics: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.

PO7: Life-long Learning: Recognise the need, and have the ability, to engage in independent learning for continual development as a computing professional.

PO8: Project management and finance: Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO9: Communication Efficacy: Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

PO10: Societal and Environmental Concern: Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.

PO11: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

PO12: Innovation and Entrepreneurship: Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

Contribution ***1: Reasonable*** ***2: Significant*** ***3: Strong***

Mapping of Programme Educational Objectives with Programme Outcomes

A broad relation between the Programme Objective and the outcomes is given in the following table:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
PEO1	3	3	2	1	3	2	2	1	2	1	2	2
PEO2	2	2	3	1	1	3	3	3	3	3	3	2
PEO3	2	3	2	2	3	2	3	1	2	2	1	3

Mapping of Program Specific Objectives with Programme Outcomes

A broad relation between the Program Specific Objectives and the outcomes is given in the following table:

PROGRAM SPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
PSO1	3	3	3	3	3	2	1	2	2	2	1	2
PSO2	3	3	3	2	3	2	1	2	1	1	2	2
PSO3	3	3	3	3	2	2	2	2	1	1	1	2
PSO4	2	2	3	1	1	2	1	3	2	1	1	3

DEPARTMENT OF COMPUTER ENGINEERING & APPLICATIONS

GLA UNIVERSITY,

MATHURA (U.P.) INDIA

COURSE STRUCTURE

Bachelor of Computer Applications (BCA)

Under

Choice Based Credit System (CBCS)

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BCAC0001	Programming Logic Using 'C'	4	0	0	4	4
2.	BCAC0002	Fundamentals of Computer and IT	4	0	0	4	4
3.	BCAC0003	Introduction of Logical Circuit and Digital Design	3	1	0	4	4
4.	BELH0005	Remedial English	3	0	0	3	4
5.	BMAS0151	Mathematics –I	3	1	0	4	4
PRACTICALS							
6.	BCAC0800	Programming Lab	0	0	4	2	4
7.	BCAC0801	Information Technology Lab	0	0	2	1	2
8.	BCTH0101	Soft Skills -I	0	0	2	1	2
TOTAL			**16**	**4**	**8**	**23**	**28**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BCAC0004	Data Structures using 'C'	3	1	0	4	4
2.	BCAC0005	Fundamental of Database Management System	3	0	0	3	3
3.	BCAC0006	Fundamentals of Operating Systems	3	0	0	3	3
4.	BBAC0001	Management Concepts & Practices	3	2	0	4	4
5.	BMAS0152	Mathematics –II	3	1	0	4	4
PRACTICALS							
6.	BCAC0802	Data Structures using 'C' Lab	0	0	4	2	4
7.	BCAC0803	Database Management System Lab	0	0	4	2	4
8.	BCAC0804	Operating System Lab	0	0	2	1	2
9.	BELH0803	English in Practice	0	0	2	1	2
10.	BCTH0102	Soft Skills -II	0	0	2	1	2
		Total	**16**	**2**	**14**	**25**	**32**

Program Core (Computer)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BCAC0001	Programming Logic Using 'C'	4	0	0	0	4	4	
2.	BCAC0002	Fundamentals of Computer and IT	4	0	0	0	4	4	
3.	BCAC0003	Introduction of Logical Circuit and Digital Design	3	1	0	0	4	4	
4.	BCAC0004	Data Structures using 'C'	3	1	0	0	4	4	
5.	BCAC0005	Fundamental of Database Management System	3	0	0	0	3	3	
6.	BCAC0006	Fundamentals of Operating Systems	3	0	0	0	3	3	
7.	BCAC0007	Object Oriented Programming	3	0	0	0	3	3	Programming using 'C'
8.	BCAC0008	Computer Organization & Architecture	3	1	0	0	4	4	Introduction of Logical Circuit and Digital Design
9.	BCAC0009	Introduction to Python	3	0	0	0	3	3	Programming using 'C'
10.	BCAC0010	System Design & Software Engineering	3	0	0	0	3	3	
11.	BCAC0011	Computer Networks & Communication	3	1	0	0	4	4	
12.	BCAC0012	Programming in Java	3	0	0	0	3	3	Object Oriented Programming using C++
13.	BCAC0013	GUI based Programming Using Visual Basic	2	0	0	0	2	2	Object Oriented Programming using C++
14.	BCAC0014	Web Technology	4	0	0	0	4	4	Object Oriented Programming using C++
		Total	**44**	**4**	**0**	**0**	**48**	**48**	

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
PRACTICALS									
15.	BCAC0800	Programming Lab	0	0	4	0	2	4	
16.	BCAC0801	Information Technology Lab	0	0	2	0	1	2	
17.	BCAC0802	Data Structures using 'C' Lab	0	0	4	0	2	4	
18.	BCAC0803	Database Management System Lab	0	0	4	0	2	4	
19.	BCAC0804	Operating System Lab	0	0	2	0	1	2	
20.	BCAC0805	Object Oriented Programming Lab	0	0	4	0	2	4	Programming using 'C'
21.	BCAC0806	Python Programming Lab	0	0	4	0	2	4	Programming using 'C'
22.	BCAC0807	Programming in Java Lab	0	0	4	0	2	4	Object Oriented Programming using C++
23.	BCAC0808	Visual Basic Programming Lab	0	0	4	0	2	4	Object Oriented Programming using C++
24.	BCAC0809	Web Technology Lab	0	0	4	0	2	4	Object Oriented Programming using C++
		Total	**0**	**0**	**36**	**0**	**18**	**36**	

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
PROJECTS									
29.	BCAJ0950	Mini Project 1	0	0	0	0	1	0	
30.	BCAJ0951	Mini Project 2	0	0	0	0	1	0	
31..	BCAJ0971	Major Project	0	0	0	0	6	0	
		Total	**0**	**0**	**0**	**0**	**8**	**0**	

Program Elective Bouquet

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet 1									
THEORY									
1.	BCAE0001	Advanced Database Management System	3	0	0	0	3	3	DBMS
2.	BCAE0002	Enterprise Resource Planning	4	0	0	0	4	4	
3.	BCAE0003	Software Project Management	4	0	0	0	4	4	System Design & Software Engineering
4.	BCAE0004	Management Information System and E commerce	4	0	0	0	4	4	Fundamentals of Computer and IT
5.	BCAE0005	Digital Marketing & Transformation	3	0	0	0	3	3	Computer Network & Web Technology
		Total	**18**	**0**	**0**	**0**	**18**	**18**	
PRACTICALS									
1.	BCAE0070	Advanced Database Management System Lab	0	0	2	0	1	2	DBMS

2.	BCAE0071	Digital Marketing & Transformation Lab	0	0	2	0	1	2	Computer Network & Web Technology
		Total	**0**	**0**	**4**	**0**	**2**	**4**	

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet 2									
THEORY									
1.	BCAE0101	Introduction to Artificial Intelligence	4	0	0	0	4	4	Data Structure Using 'C'
2.	BCAE0102	Software Testing	4	0	0	0	4	4	Software Engineering
3.	BCAE0103	Cyber Security	4	0	0	0	4	4	Computer Network
4.	BCAE0104	Data Mining & Warehousing	4	0	0	0	4	4	DBMS
5.	BCAE0105	Discrete Structure & Graph Theory	3	1	0	0	4	4	
6.	BCAE0106	Design and Analysis of Algorithms	3	1	0	0	4	4	Data Structure Using 'C'
		Total	**22**	**2**	**0**	**0**	**24**	**24**	

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet 3									
THEORY									
1.	BCAE0201	Programming in Advanced Java	3	0	0	0	3	3	Object Oriented Programming using C++
2.	BCAE0202	Introduction to Distributed System	4	0	0	0	4	4	Fundamentals of Operating Systems
3.	BCAE0203	Introduction to Cloud Computing	4	0	0	0	4	4	Computer Network
4.	BCAE0204	Introduction to Big Data	3	0	0	0	3	3	
5.	BCAE0205	Introduction to Internet of Things	4	0	0	0	4	4	Computer Organization & Computer Network
6.	BCAE0206	.Net Framework using VB.Net	3	0	0	0	3	3	Object Oriented Programming using C++
		Total	**21**	**0**	**0**	**0**	**21**	**21**	
PRACTICALS									
1.	BCAE0270	Advanced Java Lab	0	0	2	0	1	2	Object Oriented Programming using C++
2.	BCAE0271	Introduction to Big Data Lab	0	0	2	0	1	2	
3.	BCAE0272	VB.Net Programming Lab	0	0	2	0	1	2	Object Oriented Programming using C++
		Total	**0**	**0**	**6**	**0**	**3**	**6**	

Program Core of Basic Science

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet 4									
THEORY									
1.	BMAS0151	Mathematics –I	3	1	0	0	4	4	
2.	BMAS0152	Mathematics –II	3	1	0	0	4	4	
3.	BMAS0153	Optimization Methods	3	1	0	0	4	4	
		Total	**9**	**3**	**0**	**0**	**12**	**12**	

Program Core of Humanities

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet 5									
THEORY									
1.	BELH0005	Remedial English	3	0	0	0	3	3	
2.	BBAC0001	Management Concepts & Practices	4	0	0	0	4	4	
3.	BCHS0202	Environmental Studies	2	0	0	0	2	2	
4	BELH0006	Ethics & Values	2	0	0	0	2	2	
		Total	**10**	**2**	**0**	**0**	**11**	**12**	
PRACTICALS									
1.	BELH 0803	English in Practice	0	0	2	0	1	2	
2.	BELH 0804	Effective Communication and Personality Development	0	0	2	0	1	2	
3.	BELH 0805	Professional Communication & Behavioral Grooming	0	0	2	0	1	2	
4.	BCTH 0101	Soft Skills -I	0	0	2	0	1	2	

5.	BCTH 0102	Soft Skills -II	0	0	2	0	1	2	
6.	BCTH 0103	Soft Skills -III	0	0	4	0	2	4	
7.	BCTH 0104	Soft Skills -IV	0	0	4	0	2	4	
8.	BCTH 0105	Soft Skills -V	0	0	4	0	2	4	
		Total	**0**	**0**	**22**	**0**	**11**	**22**	

Summary of Credits for BCA

S. No.	Title	Credits
1	Program Core (Computer)	66
2	Project	8
3	Program Core (Humanities)	22
4	Basic Science	12
5	Program Elective (Computer)	32
	Total	**140**

BCAC0001: PROGRAMMING LOGIC USING 'C'

Objective: *This course is designed to provide a comprehensive study of the C programming language. It stresses the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code. The nature of C language is emphasized in the wide variety of examples and applications and to learn and acquire art of computer programming. To know about some popular programming languages and how to choose Programming language for solving a problem.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** History, Facilities, Concepts, Uses; Basic Program Structure, Header-Files, Comments; A Simple C program, Identifiers, Basic Data Types and Sizes, Constants, Variables, Arithmetic, Relational and Logical Operators, Increment and Decrement Operators, Conditional Operator, Bit-wise Operators, Assignment Operators, Expressions, Type Conversions, Conditional Expressions, Precedence and Order of Evaluation. **Input-Output Functions:** Data Input and Output getchar(), putchar(), scanf(), printf(), functions. **Control Flow**: If-Else, While, Do-while, Goto, For Statements, Nested Control Structures, Switch, Break, Continue Statements, Comma Operator.	26
II	**Arrays & Functions:** Arrays Defining, Processing Array, Introduction to Multidimensional Arrays; gets(), puts() functions, Functions Types, Parameters, Prototypes, Passing Arrays to Functions, Recursion, Passing Arguments to a Function by Value; **Storage Classes:** Automatic, External, Static, Register Variables in Single File Environment. **Pointer:** Usage of Pointers, Addresses and Types, Pointer and Address Arithmetic, Pointer Operations and Declarations, Using Pointers as Function Arguments (Call By Reference, Call By Value), Pointer Array Duality Strings Arrays of Pointers, Pointers to Functions, Concept of Dynamic Allocation of Memory, Pre-Processor Directives. **Other Data Types:** Structures, Member Accessing, Pointers to Structures, Structures and Functions, Arrays of Structures, Unions, Enumerations and Bit Fields, Typedef. **File Handling:** Introduction of File Handling, Modes of File Handling Uses of fopen(), fclose(), putc(), getc(), putw(), getw(), fscanf(), fprintf(), ferror() Functions.	26

Text Book:

- Yashavant P. Kanetkar, "Let us 'C' ", BPB Publication, 14th edition, 2016

Reference Books:

- Peter Vander Linden, Schaum's, "Outline of theory and problems of programming with C ", TMH.
- Peter Vander Linden, "Expert C programming", PHI.
- Balagurusamy E "Computing Fundamentals and C Programming", TMH.

Focus: This Course focuses on Employability under CO1,CO2.
Outcome: *A student who successfully completes the course will have the ability to:*

- CO1. Analyze a given problem and develop an algorithm to solve the problem.
- CO2. Design, develop and test programs written in 'C' .
- CO3. Write, compile and debug programs in C language.
- CO4. Use different data types in a computer program.

- CO5. Design programs involving decision structures, loops and functions.
- CO6. Explain the difference between call by value and call by reference
- CO7. Understand the dynamics of memory by the use of pointers and Structures.
- CO8. Use different data structures and create/update basic data files.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2/PSO3
CO3	PO1,PO3/PSO1,PSO3
CO4	PO2,PO3/PSO2
CO5	PO1,PO3/PSO1,PSO2
CO6	PO2/PSO3
CO7	PO1,PO3/PSO1
CO8	PO3/PSO1,PSO3

BCAC0002: FUNDAMENTALS OF COMPUTER AND IT

Objective*: The objective of this course is that students will be able to learn basic fundamentals and concepts related to computer architecture.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Computer Fundamentals:** Block Structure of a Computer, Characteristics of Computers, Generation of Computers and Classification of Computers. **Programming Languages:** Classification, Machine Code, Assembly Language, Higher Level Language and Fourth Generation Languages. **Number System:** Bit, Byte, Binary, Decimal, Hexadecimal and Octal Systems, Conversion from One System to the Other; Binary Arithmetic Addition, Subtraction and Multiplication. **Information Concepts & Processing System:** Evolution of Information Processing, Data, Information, Knowledge & Wisdom. **Elements of a Computer Processing System: Hardware -** Input-Output Devices, VDU, CPU Storage Devices and Media. **Software Concepts**: Type of Software, Translator, Compiler, Interpreter, Assembler, Loader. **Application Software:** Office Automation.	26
II	**Operating System:** Concepts as Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System. **DOS:**Command Interpreter, Booting Internal & External Commands, Batch Files, exe, com, System Files, bin, txt, bmp Files. **Computer Network and Communication:** Network Types, Network Topologies; Data Communication – Mode, Channel, and Media; OSI Reference Model, TCP/IP, Data Communication Equipment/Devices. **Internet and its Applications:** E-Mail, TELNET, FTP, World Wide Web, Internet and Applications.	26

Text Book:

- P.K. Sinha, "Computer fundamentals", BPB Publisher, New Delhi, 4thedition., 2008.

Reference Books:

- Anita Goel, "Computer fundamentals", Pearson Education.
- Peter Nortron, "Inside PC", TMH, New Delhi.
- Alexis Leon, Methews Leon, "Fundamentals of Information Technology", Vikas Publishing, New Delhi, 1999.

Focus: This Course focuses on Employability under CO1, CO2.
Outcome: After completion of course, student will be able to:
- CO1: Understand the basic concepts of computer hardware and software.
- CO2: Demonstrate problem solving skills.
- CO3: Understand the structure of operating system, its applications and commands.
- CO4: To be familiar with network tools, concepts of protocols and network interfaces.
- CO5: Understands the concept of Computer's Input/output devices.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2/PSO3
CO3	PO1,PO3/PSO1,PSO3
CO4	PO2,PO3/PSO2
CO5	PO1,PO3/PSO1,PSO2

BCAC0003: INTRODUCTION OF LOGICAL CIRCUIT AND DIGITAL DESIGN

Objective: *The aim of the subject is to assist the student to understand the fundamentals of digital electronic circuits and to develop the understanding regarding application of elementary ideas of digital electronics in modern technology*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction** to Digital Computer, Digital and analog signal, Block diagram of digital computer. **Number systems:** Data representation - Binary, Octal, Decimal, Hexadecimal, Conversion from one to another number system. Representation of Positive & Negative numbers; r's and r-1's Complement, Uses of Complement, Arithmetic Operation on Binary Numbers. **Binary codes:** BCD, ASCII, EBCDIC coding, Gray codes and Excess – 3 codes, alphanumeric representation in ASCII codes. Error-detection codes, even and odd parity. **Boolean Algebra:** Logic gates, Logic expression, Rules and Laws of Boolean algebra, Demorgan's theorems. Minterms, Maxterms, Boolean expression in SOP form and POS form, Conversion of SOP/POS expression to its standard SOP/POS form. Simplifications of Logic equations using laws of Boolean algebra and Karnaugh map. Universal gates, Logic circuit implementation of Boolean expression, Multilevel NAND and NOR implementation.	20
II	**Combinational circuits:** Adder, Subtractor, Comparator, Decoder, Encoder, Code conversion, Multiplexer, Demultiplexer, Parity bit Checker and Generators; Parallel binary adder/Subtractor, ROM and PLA. **Sequential Circuits** **Flip Flops:** Latch, Race around condition, Flip Flops - RS Flip flop using NAND/NOR gates, clocked RS, JK Flip flop, Master slave JK, D Flip flop, T Flip flop, edge triggered flip-flop, conversion of flip-flops, **Register: -** Definition, shift register with parallel load. **Shift Registers:** Shift registers function, serial and parallel shift registers, bi-directional shift registers with parallel load. **Counters:** Asynchronous and synchronous counters, up/down counters, modulo-n counters, BCD counters.	20

Text Book:

- Morris Mano, "Digital Logic and Computer Design", PHI, New Delhi, 2005.

Reference Books:

- R.P.Jain, "Digital Electronics", Tata McGraw Hill, New Delhi, 3rdedition, 2006.
- Anand Kumar, "Switching Theory", PHI Publication, New Delhi, 2009.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome:

- CO1: Acquired knowledge about basics of digital electronics.

- CO2: Acquired knowledge about solving problems related to number systems and Boolean algebra.
- CO3: Ability to identify, analyze and design combinational circuits.
- CO4: Ability to design various synchronous and asynchronous sequential circuits.
- CO5: Acquired knowledge about internal circuitry and logic behind any digital system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2/PSO3
CO3	PO1,PO3/PSO1,PSO3
CO4	PO2,PO3/PSO2
CO5	PO1,PO3/PSO1,PSO2

BCAC0004: DATA STRUCTURE USING 'C'

Objective: *The objective of this course is that students will have the knowledge to impart the basic concepts of data structures, abstract data type and algorithms, understand the concept of time and space complexity, Understand concepts about searching and sorting techniques and understand basic concepts about array stacks, queues and trees.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Data, Information, Introduction to Data Structure, Classification Data Structure, Primitive and Composite Data Structure, Time and Space Complexity of Algorithms. **Arrays:** Definition of an Array, Positional Value of a Member, Base Address of Array, Representation of Array (Single & Multi-Dimensional Arrays), Accessing Array element, String Processing (String Operation, Pattern Matching Algorithm), Address Calculation of Array, Insertion and Deletion on Array, Advantages and Disadvantage of Arrays. **Linked List:** Pointers, Dynamic Memory Allocation, Singly Linked Lists, and Operations on Linked Lists, Insertion and Deletion of a Node, Introduction to Circularly Linked Lists and Doubly Linked Lists. **Stack and Queue:** The Concept of List, Introduction to Stack & Primitive Operation on Stack; Stacks Application**:** Infix, Post Fix, Prefix and Recursion;	20
II	**Introduction to Queues**: Primitive Operations on the Queues, Circular Queue, Deque, Priority Queue, Applications of Queue. **Trees:** Basic Terminology, Binary Trees, Tree Representations as Array & Linked List, Basic Operation on Binary Tree, Binary Search Tree(BST), Insertion and Deletion in BST. **Traversal of Binary Trees:** Inorder, Preorder & Postorder; Application of Binary Tree. **Searching Techniques**: Linear and Binary Search; **Sorting:** Internal and External sorting, Bubble, Insertion, Selection.	20

Text Book:

- Lipschutz & Lipson, , “Data Structure using ‘C’ ”, Tata McGraw-Hill, New Delhi, 2006.

Reference Books:

- Tanenbaum, “Data Structures Using ‘C’ ”, Pearson education, New Delhi, 2ndedition. ,2005.
- Robert L. Kruse, “Data Structures and Program Design in ‘C’ ", Pearson education, New Delhi, 2ndedition, 2005.
- Esakov and Weises, “Data Structures: An Advanced Approach Using 'C' ”, PHI Publication, New Delhi, 3rdedition. ,2007
- D. Samantha, “Classical Data Structure”, PHI Publication, New Delhi, 2006.
- G. S. Baluja, “Data Structure Through ‘C’ ”, DRP, New Delhi, 2006.

Focus: This Course focuses on Employability under CO1, CO2,CO4.

Outcome: *After completion of course, student will be able to:*

- CO1: Understand the concepts of data type and array data structure.
- CO2: Analyze algorithms and determine their time complexity.
- CO3: Understand the concepts of linear data structure such as array, linked list.
- CO4: Implement arrays and linked list data structure to solve various problems.
- CO5: Understand and construct various searching algorithms such as linear search and binary search.

- CO6: Understand and construct various sorting algorithms such as insertion sort, selection sort, and bubble sort.
- CO7: Understand the concepts of non-linear data structure such as tree.
- CO8: Understand the basic concepts of STACK and QUUEUE data structure.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2/PSO3
CO3	PO1,PO3/PSO1,PSO3
CO4	PO2,PO3/PSO2
CO5	PO1,PO3/PSO1,PSO2
CO6	PO2/PSO3
CO7	PO1,PO3/PSO1
CO8	PO3/PSO1,PSO3

BCAC0005: FUNDAMENTAL OF DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the subject is to assist the student to understand the role of a database management system in an organization along with to Gain a good understanding of the architecture and functioning of database management systems as well as associated tools and techniques, principles of data modeling using entity relationship and develop a good database design and normalization techniques to normalize a database.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Basic Concepts:** Database & Database users, Characteristics of the Database, DBA, Data models, Schema & Instances, DBMS Architecture & Data Independence, Data Base Languages, Data Modeling using the Entity Relationship Approach. Data Models- Relational, Network, Hierarchical. **File Organization Techniques**: Sequential file organization, Index File Organization, Random file organization. **Relational Model concepts:** Relational Data Model Concepts, Relational Algebra,	20
II	**Introduction on SQL:** Data definition and Data manipulation command in SQL, views and queries in SQL, Specifying Constraints & index in SQL. **Normalization:** Functional dependencies, normal forms based on primary keys (1NF, 2NF, 3NF & BCNF"), de-normalization, lossless join & dependency preserving decomposition. **Transaction:** Introduction, Properties (Atomicity, Consistency, Isolation, Durability), Transaction State. Concept of object oriented data base, distributed database and client server database.	20

Text Book:

- Henry F. Korth Abraham silberschatz, "Database system concepts - McGraw - Hill International", New Delhi,5 th.ed, 2006.

Reference Books:

- Bipin Desai, "An Introduction to Database System", West Pub. Co, 2006.
- Jeff Parkins and Bryan Morgan, "Teach Yourself SQL in 14 days".
- Elmasri and Navathe ,"Fundamentals of Database Systems", 6th edition., Addision Wesley., 2010.

Focus: This Course focuses on Employability under CO1,CO2, CO6.

Outcome:

- CO1: Understand the basic concepts and the applications of database systems and relational database.
- CO2: Construct an Entity-Relationship (E-R) model from specifications and to transform to relational model.
- CO3: Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.
- CO4: Construct SQL queries to perform CRUD operations on database. (Create, Retrieve, Update, Delete)
- CO5: Understand the concept of transaction in database.
- CO6: Apply the concepts of normalization and de-normalization to remove database anomalies.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1/PSO1
CO2	PO1, PO3/PSO1
CO3	PO2/PSO1
CO4	PO2, PO3/PSO1
CO5	PO1/PSO1
CO6	PO1/PSO3

BCAC0006: FUNDAMENTALS OF OPERATING SYSTEMS

Objective: *The objective of this course is that students will able to know about facilities and services provided by operating system and able to design applications.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	Basic Elements, Functions and Types of Operating System, Serial Processing, Multi- Programmed, Batch System, Time Sharing Systems, System Components, Operating System Services, Interrupts, Interrupt Processing, **Process Management**: Concept of Process, Process Control Block, Performance Criteria of Process, Schedulers, CPU Scheduling Algorithm, Shell Layer Architecture of UNIX. **Memory Management**: Memory Hierarchy, Memory Allocation Scheme, Contiguous allocation, Paging, Page Table Structures, Segmentation, Segmentation with Paging.	20
II	**Virtual Memory**: Demand Paging, Page Replacement and its Algorithms, Thrashing. **I/O Management**: I/O Communication Techniques, DMA. **Process Synchronization:** Critical Section Problem, Two Process Solution, Semaphores, Classical Problem of Synchronization- Bounded Buffer Problem-Producer Consumer Problem And Dinning Philosopher Problem. **Deadlock**: Deadlock Characterizations, Method for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock. **File System**: Concept, Function of File System, Access Methods, Allocation Methods, Directory System and Protection. **Disk Management:** Disk Structure, Disk Scheduling Algorithm.	20

Text Book:

- Silberschatz & Galvin, “Operating System Concepts”, Addison Wesley Publication, Singapore, 7thedition, 2006.

Reference Books:

- W. Stallings, “Operating System”, Prentice Hall of India. New Delhi, 6thedition, 2006
- Harold Lorin, Harvey M. Deitel, “Operating systems ”, Addison Wesley, New Delhi, 2ndedition, 2005.
- M. Naghibzadeh, “Operating System”, University Press.

Focus: This Course focuses on Employability under CO1, CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Understand the concepts related to functions and services of operating system.
- CO2: Describe, contrast and compare different structures of operating system.
- CO3: Understand and analyze theory and implementation of processes, resource control, physical and virtual memory concepts, scheduling, I/O and file management.
- CO4: Acquire a detailed understanding of aspects of different operating systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO4/PSO1,POS3

CO4	PO3,PO4,PO6/PSO3,PSO4

BCAC0007: OBJECT ORIENTED PROGRAMMING

Objective: *The objective of this course is that the students will able to develop a greater understanding of the issues involved in programming language design and implementation and having in-depth understanding of functional, logic, and object-oriented programming paradigms.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Fundamentals of Object Oriented Programming:** Procedure Oriented Programming vs. Object Oriented Programming (OOP). **Object Oriented Programming Concepts:** Classes, Objects, Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Passing and Abstraction; Benefits and Applications of Object Oriented Programming. **Introduction to C++:** What is C++, A Simple C++ Program, Structure of C++ Program, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, and Manipulators. **Functions In C++:** Call by Value & Reference, Inline Function, Default Arguments, Function Overloading. **Classes And Objects**: Creation of Class, Accessing Class Members, Private vs Public Objects, Member Functions, Method Definition, Constant Member Functions, Overloading Member Functions, Array within a Class, Memory Allocation for Objects, Static Data Members and Static Member Functions, Arrays of Objects, Objects as Function Arguments, Friend Functions, and Returning Objects. **Constructor and Destructor:** Introduction to Constructors Parameterized Constructors, Multiple Constructors in a Class, Constructor with Default Arguments, Copy Constructors. **Operator Overloading:** Defining Operator Overloading, Overloading Unary Operator, Overloading Binary Operators, Overloading Binary Operators Using Friend, Rules for Overloading Operators.	20
II	**Inheritance:** Introduction, Defining Derived Classes, Types of Inheritance- Single, Multiple, Multilevel, Hierarchical, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, and Constructors to Derived Classes. **Pointers, Virtual Functions:** Introduction, Pointers to Objects, Virtual Function Pure Virtual Functions, Object Slicing. **Templates** Function & Class Templates, Class Templates with Multiple Parameters. **Exception Handling:** Introduction, Basics of Exception Handling, Exception Handling Mechanism, Throwing Mechanism, Catching Mechanism, Rethrowing an Exception	20

Text Book:

- E. Balaguruswamy, “Object Oriented Programming in C++”, TMH Publishing Co. Ltd., New Delhi, 4th edition, 2006.

Reference Books:

- Jense Liberty Tim Keogh, C++, “An Introduction to Programming”, BPB Publications, New Delhi
- Robert Lafore, “OO Programming in C++”, Galgotia Publications Pvt. Ltd., Daryaganj, New Delhi, 2006
- Stephen Parata, “C++ Premier by”, TMH Publishing Co. Ltd., New Delhi 1st edition., 1996.

Focus: This Course focuses on Employability under CO1,CO2,CO4.
Outcome: After completion of course, student will be able to:

- CO1: Understand the difference between the top-down and bottom-up approach
- CO2: Apply the concepts of object-oriented programming
- CO3: Illustrate the use of predefined and user defined functions
- CO4: Apply C++ features to program design and implementation.
- CO5: Implements constructors, default constructors, and abstract methods.
- CO6: Understand operator overloading concepts and apply to develop programs related to overloading operators
- CO7: Understand object-oriented concepts and explain the features and peculiarities of the C++ programming language.
- CO8: Apply virtual and pure virtual function concepts in real world problems

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1 /PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/ PSO2
CO7	PO1,PO2,PO11/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO2

BCAC0008: COMPUTER ORGANIZATION AND ARCHITECTURE

Objective: *The objective of this course is that the students will be able to conceptualize the basics of organizational and architectural issues of a digital computer and to analyze performance issues in processor and memory design of a digital computer. To understand various data transfer techniques in digital computer.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction to Computer Organization and Computer Architecture:** Introduction, Von-Neumann and Harvard Architecture; Register Transfer Language, Register Transfer, Bus and Memory Transfer. **Micro operations:** Arithmetic, Logic Micro Operations and Shift Micro Operations, Macro Operations; Instruction Code, Computer Registers. **Computer Instructions:** Instruction Types, Memory Reference Instructions, Input-Output, Instruction Cycle, Timing and Control; Interrupts, Types of Interrupt, Interrupt Cycle. **Introduction to CPU:** General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, RISC vs. CISC, Parallel Processing, Applications,	20
II	**Pipelining:** Arithmetic Pipeline, Instruction Pipeline, Pipeline Difficulties and Resolution, Vector Processing and its Applications; Flynn's Classification, Control Unit, Micro-Programmed Control, Data Path Design, Bus Organization. Peripheral Devices, Input Output Interface, Asynchronous Data Transfer. **Modes of Transfer:** Programmed I/O, Interrupt I/O, Direct Memory Access (DMA); Memory Hierarchy; **Cache memory:** Locality of References, Types of Cache, Characteristics, Mapping of Cache, Cache Coherency Problem.	20

Text Book:

- M. Morris Mano, "Computer System Architecture", Publication- PHI, New Delhi, 3rdedition, 2007.

Reference Books:

- Carl Hamacher, "Computer Organization", McGraw Hill, New Delhi, 5thedition, 2002.
- John P. Hayes, "Computer Architecture and Organization" McGraw-Hill. New Delhi, 3rdedition., 1998.

Focus: This Course focuses on Employability under CO1, CO2,CO3.
Outcome: After completion of course, student will be able:

- CO1: To understand basic structure of computer and to perform computer arithmetic operations.
- CO2: To understand control unit operations and to design memory organization that uses banks for different word size operations.
- CO3: To understand the concept of cache mapping techniques and to understand the concept of I/Oorganization.
- CO4: To conceptualize instruction level parallelism.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO1,PO3/PSO1
CO3	PO2,PO3,PO5/PSO2
CO4	PO2,PO3,PO4/PSO1,PSO3

BCAC0009: INTRODUCTION TO PYTHON

Objective: *This course allows basic learning of syntax and semantics and functions in Python programming, construct data structure using OO concepts and its connectivity with database.*

Module No.	Content	Teaching Hours
I	**Introduction:** History, Features **Working with Python:** Basic Syntax, Variable and Data Types, Operator **Conditional Statements:** If, If- else, Nested if-else, elif **Looping:** For, While, Nested loops **Control Statements:** Break, Continue, Pass **Lists:** Introduction, Accessing list, Operations, Working with Lists, List **Tuple:** Introduction, Accessing tuples, Operations Working, Functions and Methods **String Manipulation:** Accessing Strings, Basic Operations, String slices, Function and Methods **Dictionaries:** Introduction, Accessing values in dictionaries, working with dictionaries, Properties and Functions **Functions and Methods** **Functions:** Defining a function, calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables. **Input-Output:** Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Inbuilt-Functions	20
II	**Modules:** Importing a module, Math module, Random module, Packages, Composition. **Exception Handling:** Exception, Exception Handling, Except clause, Try & finally clause, User Defined Exceptions **OOPs concept:** Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding, Use of self method, _init_ method **Regular expressions:** Match function, Search function, Matching VS Searching, Modifiers, Patterns **Database:** Introduction, Connections, Executing queries, Transactions, Handling error **Multithreading:** Thread, Starting a thread, Threading module, Synchronizing threads, Multithreaded Priority Queue.	20

Text Books:

- Charles Severance, "Python for Informatics", 1st edition., CreateSpace Independent Publishing Platform, 2013.
- Peter Wentworth, Jeffrey Elkner, Allen B. Downey, and Chris Meyers , "How to Think Like a Computer Scientist: Learning with Python", 2nd edition., Open Book Project, 2012.

Reference Books:

- Mark Lutz ,"Learning Python", 5th edition., O'Reilly Media, 2013.
- Wesley Chun , "Core Python Applications Programming", Prentice Hall, 3rd edition, 2012.
- Alex Martelli, "Python in a Nutshell", 2nd edition., O'Reilly Media, 2006.

Focus: This Course focuses on Employability under CO1,CO3.

Outcome: By the end of the class, students will learn to:

- CO1. Identify the Python's data type - numbers, list, tuple, string, dictionary, class.

- CO2. Recognize Python syntax, semantics, and flow control –if else, for loop, while loop, and function.
- CO3. Apply the concepts of file handling and packages.
- CO4. Understand the basic concepts - abstraction, encapsulation, inheritance, and
- polymorphism of object-oriented programming.
- CO5. Describe the basic concepts of regular expressions and exception handling.
- CO6. Demonstrate database connectivity with applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO1
CO2	PO1,PO3/PSO1
CO3	PO5/PSO2
CO4	PO3/PSO1, PSO2
CO5	PO4,PO5/PSO2, PSO3
CO6	PO5/PSO1

BCAC0010: SYSTEM DESIGN & SOFTWARE ENGINEERING

Objective: *The aim of the subject is to assist the student in understanding the basic theory of software engineering, and to apply these basic theoretical principles to a group software development project.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** System, Components, Characteristics, Types of Systems, SDLC. **Introduction to Software Engineering**: Software engineering definition, Software characteristics, Software Crisis, Types of Software. **Software process:** Waterfall, Incremental, Iterative Enhancement, Prototype, RAD and Spiral Models. **Software Requirements Engineering:** Requirement Engineering: Types of Requirements, Requirement Elicitation Techniques Like Interviews, FAST, QFD, Use case Approach, Requirements Analysis Using DFD, Data Dictionaries & ER Diagrams, Requirements Documentation, and SRS. **Software Project Planning:** Size Estimation like Lines of Code & Function Count, Cost. **Estimation Models:** COCOMO (Basic, Intermediate) **Software Risk Management:** Risk Identification and Risk Analysis	20
II	**Software Design:** Cohesion & Coupling, Classification of Cohesion & Coupling, Function Oriented Design, Object Oriented Design, Structure chart. **Coding:** Characteristics of Coding and Coding style. **Software Metrics:** Software Measurements, Token Count, Halstead Software, Measures. **Software Reliability & Quality:** Introduction of Mc Call's & Boehm's Quality Model, Capability Maturity Models **Software Reliability Models**: Basic Execution Time Model. **Software Testing:** Types of Testing, Functional Testing, Structural Testing, Unit Testing, Integration Testing and System Testing. **Software Maintenance:** Maintenance Process **Maintenance models**: Belady and Lehman Model, Boehm Model Regression Testing, Software Configuration Management; Implementation, Introduction to Reengineering and Reverse Engineering.	20

Text Book:

- P Jalote, "Integrated Approach to Software Engineering", Narosa Book Distributors Pvt. Ltd, New Delhi, 3rdedition, 2006.

Reference Books:

- K. K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International, 3rdedition, 2008.
- R. S. Pressman, "Software Engineering – A Practitioner's Approach", McGraw Hill Int., 5thedition, 2001.
- Stephen R. Schach, "Classical & Object Oriented Software Engineering", IRWIN, 1996.
- James Peter, W. Pedrycz, "Software Engineering: An Engineering Approach", John Wiley & Sons.
- I. Sommerville, "Software Engineering", Addison Wesley, New Delhi, 7thedition, 2004.

Focus: This Course focuses on Employability under CO1,CO2, CO4.
Outcome: After the completion of the course, the student will be able to:
- CO1: Understand the basic concepts of software engineering.
- CO2: Apply software processes tosolve real world problems.
- CO3: Estimate the cost, effort and schedule of software using COCOMO Model.

- CO4: Analyze the software design techniques (structure chart, SDM, sequence diagram).
- CO5: Understand the basic concepts of OO analysis and design.
- CO6: Develop the test cases to validate the software.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7/PSO1
CO2	PO2,PO3/PSO4
CO3	PO2,PO11/PSO3
CO4	PO3,PO10/PSO4
CO5	PO3,PO7/PSO1
CO6	PO5,PO12/PSO2

BCAC0011: COMPUTER NETWORKS AND COMMUNICATION

Objective: *This course is to provide students with an overview of the concepts and fundamentals of data communication and computer networks.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introductory Concept:** Data Communication, Concept, Advantages and Disadvantages of Computer Network, Line Configuration, Topology, Transmission Mode, Categories of Networks; OSI Reference Model and Functions of Layers; Comparison of OSI & TCP/IP, Signals - Analog and Digital, Bandwidth, Periodic and Aperiodic Signals; Transmission Media, Modem, Encoding and Modulation Technique, Multiplexing Techniques, Switching Techniques. Flow Control: Noisy And Noiseless Channel, Error Detection and Correction Method in Network: VRC, LRC, CRC, Checksum, Hamming Code,	20
II	Access Control: ALOHA, CSMA, CSMA/CD, Framing: Bit Stuffing and Byte Stuffing, Integrated Service Digital Network, Networking and Internetworking Device. Routing Algorithm: Link State and Distance Vector Routing, IP Addressing, Subnetting, Responsibilities of Transport Layer: UDP, TCP, Upper OSI Layers (Session, Presentation And Application).	20

Text Book:

- Behrouz A . Frouzan, "Data communication and network", TMH, 6thedition, 2007.

Reference Books:

- Tanenbaum A. S., "Computer Networks", edition., Pearson Education, 4thedition, 2007.
- Stallings W, "Data and Computer Communication", TMH 8thedition, 2007.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: After completion of this course the student will be able to:

- CO1: Understand basic computer network technology.
- CO2: Understand and explain Data Communications System and its components.
- CO3: Identify the different types of network topologies and protocols.
- CO4: Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
- CO5: Identify the different types of network devices and their functions within a network.
- CO6: Understand and building the skills of subnetting and routing mechanisms.
- CO7: Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO12/PSO1
CO2	PO1/PSO2
CO3	PO1,PO4/PSO1,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO4,PO6/PSO3
CO6	PO2,PO4/PSO1
CO7	PO5,PO12/PSO2

BCAC0012: PROGRAMMING IN JAVA

Objective: *The objective of this course is that the students will understandthe foundation of good programming skills by discussing key issues to the design of object-oriented programming.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to Java, History of Java, Features of Java, Importance of Java, Byte Code, JVM, JRE, JDK,JIT, Java Implementation, Application of Java, Sample Program & Compilation, Lexical Issues (White Space, Identifiers, Literals, Comments, Separators, Keyword). **Data Type, Operators, Control Structures:** Variables, Constants, Declaration, Literals, Scope of Variable, Type Casting, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operator, Dot Operators, Control Statements. **Array:** Declaration, Creation, Initialization, Length, Two-Dimensional Arrays, Command-Line Arguments. **String Handling**: Predefined Functions in String, String Methods **Introduction of Classes, Objects and Methods:** Introduction to Object Class Defining Class, Adding Variables, Adding Methods, Creating Objects, **Constructors**: Types of Constructors, Keyword this & static, Garbage Collection	20
II	**Inheritance:** Inheritance, Types of Inheritance, , Creating Multilevel Hierarchy, Method Overloading & Overriding, Dynamic Method Dispatching, final keyword, Abstract Class. **Packages And Interfaces:** Defining Interfaces. Extending and Implementing Interfaces Defining Packages, Access Protection, Importing Packages, **Exception Handling:** Exception Types, Multiple Catch Clauses, Nested Try Statements, Throw, Throws, Finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses. **Multithreaded Programming:** Thread Life Cycle, Creating Threads, Thread Methods, Thread Priority **Introduction to Applet Programming-** Introduction to Applet ,Applet Architecture ,Applet Life Cycle, Applet Class, Applet Tag, Passing Parameters, Use of Graphics Class, Applet Methods.	20

Text Book:

- Naughton, Schildt, "The Complete Reference JAVA2", 7th edition., TMH.

Reference Books:

- Naughton Patric, Morrision Michel, "Java Hand Book", Osborne/McGraw-Hill, 5thedition, 2006.
- Balaguruswami E., "Programming with Java", TMH, 3rdedition, 2007.
- Decker & Hirshfied, "Programming Java", Vikas Publication 2ndedition, 2000.

Focus: This Course focuses on Employability under CO1 ,CO2.

Outcome: After completion of course, student will be able to:

- CO1: Understand differences between procedures oriented and object oriented approach.
- CO2: Understand the relevance of Object Oriented Programming techniques.
- CO3: Understand how to write, compile and execute a Java Program.
- CO4: Understand the use of polymorphism and Inheritance.
- CO5: Understand how to define user exceptions and its uses.
- CO6: Understand what is a thread and Multithreading model.
- CO7: Understand how to develop a GUI application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1 /PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/ PSO2
CO7	PO1,PO2,PO11/PSO2

BCAC0013: GUI BASED PROGRAMMING USING VISUAL BASIC

Objective: *The objective of this course is to get a simple understanding about procedural and event driven programming language. Emphasis on writing programs using ActiveX controls, loops, event-driven programming, methods, arrays and connecting database so that students can develop windows based applications using Visual Basic.*

Credits: 02 **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Visual Programming Overview and Environment:** Need of Visual Programming, Event Driven Programming, Integrated Development Environment (Menu Bar, Title Bar, Tool Bar, Tool Box and Various Types of Windows). **BasicActiveX Controls:** Command Button, Text Box, Label **Program Elements:** Variables, Constant, Operators, Data Types, Conditional Statements. **Program Elements and Controls :** Loops in VB, Procedures, User Defined Functions, In-Built Functions,	13
II	**Array:** Static and Dynamic; Picture Box, List Box, Timer **Database Controls and Connectivity** **Dialog Boxes:** Inputbox( ), Msgbox( ), SDI , MDI Menu Editor, Accessing Data Using Data Access Objects, Data Control	13

Text Book:

- Evangelos & Petroutsos, , "Mastering Visual Basic 6", BPB Publication, New Delhi, 1stedition, 2007.

Reference Books:

- Gary Cornell, "Visual Basic 6", Tata McGraw Hill, New Delhi, 20thedition, 2005.
- Noel Jerke, "Visual Basic 6 (The Complete Reference)", Tata McGraw Hill, New Delhi.
- Eric A. Smith, "Visual Basic 6 Programming Bible", Wiley India, New Delhi, 2000.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: Upon completion of this course, the student will be able to:

- CO1: Identify the differences between the procedural languages and event-driven languages.
- CO2: Design, create, build, and debug Visual Basic applications.
- CO3: Explore Visual Basic's Integrated Development Environment (IDE).
- CO4: Write Visual Basic programs using object-oriented programming techniques including classes, objects, methods, instance variables, composition and inheritance and polymorphism.
- CO5: Write Windows applications using forms, controls, and events.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO,PO2,PO3, PO5, PO9/PSO1
CO2	PO,PO2,PO3, PO5, PO9/PSO1
CO3	PO,PO2,PO3, PO5, PO9/PSO1
CO4	PO,PO2,PO3, PO5, PO9/PSO3
CO5	PO,PO2,PO3, PO5, PO9,PO11,PO12/PSO3

BCAC0014: WEB TECHNOLOGY

Objective: *This course is designed to provide a comprehensive study of the evolution of the Internet and the WWW and its underlying web technologies and to understand the design concepts of static and dynamic web pages.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Web Designing:** Web Page, Website, Web Browser, WWW, Internet, e-Mail **Overview of HTML:** HTML Markup Tags, Linking, Tables and Form. **Form Controls:** Text Field, Password Field, Multiline Text Area, Drop Down List, Check Box, Radio Buttons, Scrolled List, Reset Button, Submit Button, File Field etc. **Overview of DHTML:** Introduction, Document Object Model (DOM), Introduction to Cascading Style Sheets (CSS). **VB Script:** Introduction, Adding Script to Documents, Data types, Operators. **Variables:** Global & Local Variables, Input and Output Statements, Built in Functions, Arrays.	26
II	**Control Statements:** if statement, if-then-else, Nested if, Select case Statement. **Looping Statements:** for…next, do-while, do-until Statements. **Events in VB Script** **JAVA Script:** Introduction, Adding Script to Documents, Data Types, Operators, Variables, Input and Output Statements, Built in Functions, Arrays, if Statement, switch Statement. **Looping statements:** while, do-while, for Statement. **Events in JavaScript**.	26

Text Book:

- Bates, Chris, "Web Programming – Building Internet Application", Wiley-Dream tech, 3rd edition, 2006.

Reference Books:

- Holzener, Steven, "Inside XML", Tech-media publication, 1st edition 2001.
- Bergstan, Hans, "Java Server Page", O'Reilly Publication, 3rd edition, 2004.
- Burdman, Jessica, "Collaborative Web Development", Addison Wesley, 2000.
- Stalling, William, "Cryptography and networks security: Principles and Practice" Prentice Hal, 5th edition, 2011.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: After completion of course, student will be able to:

- CO1: Understand the concepts of www, evolution of www and internet and various client server architecture.
- CO2: Understand the concept of HTML and various tags of html.
- CO3: Understand the concept of adding style in html document.
- CO4: Understand the design of web site using JavaScript.
- CO5:Understand the design of web site using JavaScript.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO,PO2,PO3, PO5, PO9/PSO1
CO2	PO,PO2,PO3, PO5, PO9/PSO1
CO3	PO,PO2,PO3, PO5, PO9/PSO1
CO4	PO,PO2,PO3, PO5, PO9/PSO3
CO5	PO,PO2,PO3, PO5, PO9,PO11,PO12/PSO3

BCAC0800: PROGRAMMING LAB

Objective: *The objective of this course is to make students understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures and File programming.*

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Lab Hours
I/II/III	**Introduction to C Programming and Linux Environment** **Operators, their precedence and associativity** • Arithmetic Operators on Integers • Arithmetic Operators on Floating point numbers • Relational Operators • Ternary Operators **Formatted Input and Output** **Decision Control** • if statement ,else statement ,else if ladder ,switch-Case statement **Programming based on loops** • for loop , while loop ,do while loop ,Nested loops **Use of special control statement** • break , continue **Programming based on Array** • One dimensional Array , Two dimensional Array **Programming based on function-call by value** • Call by Value , Recursion **Pointers** • Basics • Problem based on One dimensional array • Problem based on Two dimensional array • Dynamic Memory Allocation • Function call by reference **User Defined Data types** • Structure • Union • Enum **File handling** • Opening a file • Reading, writing and appending a file • Closing file	48

Text Book:

- Yashavant P. Kanetkar, “Let us ‘C’ ”, BPB Publication, New Delhi, 8thedition, 2008.

Reference Books:

- Peter Vander Linden, “Schaum's Outline of theory and problems of programming with C”, TMH.
- Peter Vander Linden, “Expert C programming”, PHI.
- Balagurusamy, “Computing Fundamentals and C Programming”, TMH.

Focus: This Course focuses on Employability under CO1,CO2,CO7.
Outcome: At the end of this course, students will be able to:

- CO1. Analyze a given problem and develop an algorithm to solve the problem.
- CO2. Design, develop and test programs written in 'C' .
- CO3. Write, compile and debug programs in C language.
- CO4. Use different data types in a computer program.
- CO5. Design programs involving decision structures, loops and functions.
- CO6. Explain the difference between call by value and call by reference
- CO7. Understand the dynamics of memory by the use of pointers and Structures.CO8. Use different data structures and create/update basic data files.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2/PSO3
CO3	PO1,PO3/PSO1,PSO3
CO4	PO2,PO3/PSO2
CO5	PO1,PO3/PSO1,PSO2
CO6	PO2/PSO3
CO7	PO1,PO3/PSO2
CO8	PO3/PSO1,PSO3

BCAC0801: INFORMATION TECHNOLOGY LAB

Objective: *The objective of this course would enable the students in crafting professional word documents, excel spread sheets, power point presentations using the Microsoft suite of office tools as well as having basic knowledge of hardware and operating system installation. To familiarize the students in preparation of documents and presentations with office automation tools.*

Credits: 01 L–T–P: 0–0–2

Module No.	Content	Lab Hours
I	**How A Computer System Works?** Hardware Configuration, Introduction to Basic Components of a Typical PC, Assembling a PC, Installing Operating System, Basic Troubleshooting During the Assembling, Basic Troubleshooting of PC, Introduction to Various Types of Cables and Connectors used in Networking, Introduction to Networking and Networking Concepts, Repeaters, Hubs, Switches, Bridges, Routers, Hubs vs Switches, Installing the NIC Card, MAC Address. **Ms Office XP/2007** **(A) Ms Word** **Introduction to Ms Word:** Menu Bar, Menus, Submenus, Tool Bar, Tools, Customizing Toolbar, Hiding Toolbar etc., Creating and Saving a Documents, Working with an Existing Document, Auto Text, Auto Complete and Auto Correct. **Formatting a Document :** Change the Appearance of Text & Paragraph, Copy, Paste and Paste Special Functions, Creating and Modifying a List, Change the Way Each Page Appears in the Document Giving Stress to Line and Page Break Options and Orientation, Changing the Look of Documents with Styles.	12
II	**Using Tables and Columns:** Table Creation and Modification Giving Stress to Auto-Fit, Auto-Format and Table Sort. Working with Data in Table Giving Stress to Formulas, Presenting Text in Columns, Object Linking and Embedding, Inserting and Sizing Graphics, Hyperlink Envelopes & Label Creation, Grammar & Spell Check, Previewing and Printing Documents. **(B) MS Excel** **Introduction to Electronic Spreadsheet and Microsoft Excel :** Creating and Formatting a Worksheet, Features of Excel, Inserting and Formatting Data in a Worksheet, Working with an Existing Data List, Auto Fill, Fill Series and Auto-complete Options, Formatting Cells; Sorting & Filtering Data, Conditional Formatting, Formulas and Functions (Details Usage of Important Data Functions Like Sum, If, Average etc.); Interlinking Worksheets and Files, Setting Filters and Performing Calculations on Filtered Data etc. **(C) MS Power Point** **Introduction to Power Point:** **Creating A Presentation:** Features of Power Point - Editing Master Slides, Viewing and Editing a Presentation, Inserting, Sorting, Hiding and Deleting Slides, Inserting Pictures. **Clip Art and Movies in a Slide:** Creating and Enhancing a Table, Slide Layouts, Modifying the Slides and Title Master, Adding Transition and Animation Effect, Hyper Linking Slides & Files.	12

Text Book:

- Rajaraman V, "Computer fundamentals", PHI Publisher, New Delhi, 4th edition, 2006.

Reference Books:

- Anita Goel, "Computer fundamentals", Pearson Education
- Peter Nortron, "Inside the PC", TMH, New Delhi

- P.K. Sinha, "Computer fundamentals", BPB Publisher, New Delhi, 4th edition, 2008.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able:

- CO1: To understand thoroughly the principles of hardware design in the latest technology.
- CO2: To assemble a PC, installation of OS and NIC card.
- CO3: To perform documentation.
- CO4: To perform presentation skills.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO3,PO4/PSO1
CO3	PO4/PSO2,PSO4
CO4	PO3/PSO2,PSO4

BCAC0802: DATA STRUCTURES USING 'C' LAB

Objective: *The objective of this course is that students will have the knowledge to construct and application of various data structures and abstract data types including arrays, stacks, queues and trees.*

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Lab Hours
I/II	**Array** • Introduction • Operations • String Operations • Multidimensional Array • Operations on multi dimensional array **Stack** • Push, pop and Traversing • Infix to prefix **Queue** • Implementation using array (Insertion and Deletion) • Circular Queue • Deque **Linked List** • Implementation • Operations on linked list **Implementation of Circular Linked List** **Implementation of Doubly Linked List** **Searching** • Linear Search • Binary Search **Sorting** • Insertion Sort • Bubble Sort • Selection Sort • Merge Sort • Quick Sort • Radix Sort	48

Text Book:

- Lipschutz & Lipson, "Data Structure using 'C' ", Tata McGraw-Hill, New Delhi, 2006.

Reference Books:

- Tanenbaum, "Data Structures Using 'C' ", Pearson education, New Delhi, 2nd edition, 2005.
- Robert L. Kruse, "Data Structures and Program Design in 'C' ", Pearson education, New Delhi, 2nd edition, 2005.
- Esakov and Weises, "Data Structures: An Advanced Approach Using 'C' ", PHI Publication, New Delhi 3rd edition. 2007.
- D. Samantha, "Classical Data Structure", PHI Publication, New Delhi, 2006.
- G. S. Baluja, "Data Structure Through 'C' ", DRP, New Delhi, 2006.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: After completion of course, student will be able to:
- CO1: Implement arrays and linked list data structure.
- CO2: Implement various sorting algorithms.
- CO3: Implement linear data structure such as stack, and queue.
- CO4: Implement non-linear data structure tree, using C-programming language.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2 /PSO1,PSO2
CO2	PO1,PO2/PSO1,PSO3
CO3	PO1,PO3/PSO1
CO4	PO2,PO3/PSO1,PSO3

BCAC0803: DATABASE MANAGEMENT SYSTEM LAB

Objective: *To educate students with fundamental concepts of Data Base Design, Data Models, Different Data Base Languages (SQL/Oracle).*

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Lab Hours
I/II	• Introduction of Data Definition Language (DDL) and Its commands (Create, Alter, Drop, Rename). • Introduction of Data Manipulation Language (DML) and Its Commands (Insert, Update, Delete). • Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command. • Queries to apply different types of constraints in tables. [Not Null, unique, primary key, foreign key, check, dafault] • Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING. • Queries using Conversion functions (to_char, to_number and to_date), • Queries using String functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr) • Queries using Date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date) • To implement concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views	**48**

Text Book:

- Henry F. Korth Abraham silberschatz, "Database system concepts", McGraw - Hill International, New Delhi,5 th.ed, 2006.

Reference Books:

- Bipin Desai, "An Introduction to Database System", West Pub. Co, 2006.
- Jeff Parkins and Bryan Morgan, "Teach Yourself SQL in 14 days".
- Elmasri and Navathe , "Fundamentals of Database Systems", 6th edition., Addision Wesley, 2010.

Focus: This Course focuses on Employability under CO1,CO2, CO3.
Outcome: After undergoing this laboratory module, the participant should be able to:

- CO1: Implement SQL queries to a database using SQL DDL commands
- CO2: Design and implement a database schema for a given problem-domain
- CO3: Implement SQL queries to a database using SQL DML commands.
- CO4: Implement integrity constraints on a database using a state-of-the-art RDBMS.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/PSO1,PSO2
CO2	PO1, PO3/PSO1
CO3	PO1, PO2/PSO1,PSO2
CO4	PO2, PO3/PSO1,PSO2

BCAC0804: OPERATING SYSTEM LAB

Objective: *The course is designed to provide students practical knowledge of various scheduling, page replacement and deadlock handling algorithms.*

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I/II	1. Implement the following basic commands (with options) used in UNIX/LINUX OS: a. ls b. mkdir c. cd d. cat e. man f. date g. cal h. rm i. rmdir j. head k. tail l. pwd 2. Implement the following basic commands (with options) used in UNIX/LINUX OS: a. cp b. mv c. sort d. cut e. who f. whoami g. ps h. kill i. bc j. top k. grep l. chmod 3. Implement the following basic commands (with options) used in UNIX/LINUX OS: a. nohup b. last c. more d. less e. pg f. history g. touch h. tr i. sed j. emacs k. du l. diff 4. Write and implement the basic vi editor commands. 5. **Shell scripts that uses simple commands:** a. Write a shell script to display current date in a particular format, number of users currently login and current month's calendar. b. Write a shell script to display the process name and its pid. 6. **Decision based Shell scripts:** a. Write a shell script that finds whether an entered number is even or odd. b. Write a shell script to input the name of a file as command line argument and display whether it is a file, a directory or anything else. c. Write a shell script to input the marks of a student in 3 subjects and find his grade. 7. **Shell scripts related to strings:** a. Write a shell script to input two strings from the user and determine whether they are same or not. b. Write a shell script to input a string from the user and determine its length. c. Write a shell script to input two strings from the user and find the occurrences of string2 in string 1. 8. **Shell scripts using pipes:** a. Write a shell script to input the name of a file as command line argument and display the number of characters, words and lines in the file. b. Write a shell script to display a list of directories within the current directory and how much space they consume, sorted from the largest to the smallest. 9. **Shell scripts with loop statements:** a. Write a shell script that inputs a number from the user and prints its table on the screen.	24

	b. Write a shell script to implement a timer. 10. **Implement the basic IPCS commands used in UNIX.**	

Text Book:

- Silberschatz, Galvin and Gagne ,"Operating Systems Concepts", 7th edition., Wiley, 2005.

Reference Books:

- Kernighan and Ritche ,"The C Programming Language", PHI, 2nd edition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 1st edition, 2000.

Focus: This Course focuses on Employability under CO1,CO3.
Outcome: By the end of the class, students will learn to:
- CO1: Implement CPU scheduling algorithms
- CO2: Make algorithm used for deadlock avoidance and prevention.
- CO3: Implement page replacement and memory management algorithms.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO4,PO5/PSO1,PSO2

BCAC0805: OBJECT ORIENTED PROGRAMMING LAB

Objective: *As part of this course, students will be able to design efficient computer programs to solve practical engineering problem and write programs for a wide variety problem in math, science, financials, and games.*

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Lab Hours
I/II	**Basic of C++** • if statement • if else statement • switch case statement • for loop • while loop • do while loop **Functions in C++** • Function declaration and definition • Function Overloading **Introduction of Classes and Objects** • Program to create class and objects **Operator overloading and Friend function** • Overload Unary operator. • Overload Binary operator. • Friend Function: Program to access the member of one class • Operator Overloading: Unary & Binary operator overloading with friend function **Inheritance** • Simple inheritance • Hierarchical Inheritance • Hybrid Inheritance. **Virtual Functions** • To use the same function name in Inheritance using virtual function **I/O in C++** • Use of various manipulators. • Use of different IOS class Functions For formatting of output. **Advanced Features** • Template function & classes • Try & Catch Function in Exception Handling	48

Text Book:

- E. Balaguruswamy, "Object Oriented Programming in C++", TMH Publishing Co. Ltd., New Delhi, 4th edition, 2006.

Reference Books:

- Jense Liberty Tim Keogh, C++, "An Introduction to Programming", BPB Publications, New Delhi.
- Robert Lafore, "OO Programming in C++", Galgotia Publications Pvt. Ltd., Daryaganj, New Delhi, 2006.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: Upon completion of this course, students should be able to:

- CO1: Use C++ to demonstrate practical experience in developing object-oriented solutions.
- CO2: Discover errors in a C++ program and describe how to fix them.
- CO3: Analyze a problem and construct a C++ program that solves it
- CO4:Use primitive data types, selection statements, loops, functions to write programs.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO5/PSO2
CO3	PO3,PO5/PSO4
CO4	PO5/PSO4

BCAC0806: PYTHON PROGRAMMING LAB

Objective: *The course is designed to provide basic knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language.*

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Lab Hours
I/II	**Programs based on the concepts of:** ● Basic elements of python (I/O Operations) ● Branching Programs ● Control Structures ● Strings and Input ● Iteration ● System function and their types **Usage of Data Structures:** ● Strings ● Lists ● Tuples ● Dictionary ● Modules **Programs related to Handling Exceptions** ● Try and finally clause ● User defined exceptions **Object Oriented Programming:** ● Classes and Object ● Inheritance ● Encapsulation and Data hiding ● Overloading and Overriding ● Importance of self, __init__( ) method **Regular Expressions, Database Connectivity and Multithreading:** ● Match functions, search functions and Patterns ● Connection establishment, handling errors ● Synchronizing threads, Multithreaded Priority Queue	48

Text Book:

- Allen Downey ,"Think Python: How to Think Like a Computer", 2nd edition., Green Tea Press, 2015.
- Peter Wentworth, Jeffrey Elkner, Allen B. Downey, and Chris Meyers ,"How to Think Like a Computer Scientist: Learning with Python", 2nd edition., Open Book Project, 2012.

Reference Books:

- John V Guttag "Introduction to Computation and Programming Using Python", Prentice Hall of India.
- R. Nageswara Rao, "Core Python Programming", Dreamtech.
- Wesley J. Chun. "Core Python Programming - Second edition.", Prentice Hall.
- Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: By the end of the class, students will learn to:

- CO1: To develop proficiency in creating based applications using the Python Programming Language.

- CO2: To be able to understand the various data structures available in Python programming language and apply them in solving computational problems.
- CO3: To be able to do testing and debugging of code written in Python.
- CO4: To be able to do text filtering with regular expressions in Python.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO4
CO2	PO4/PSO1
CO3	PO5/PSO4
CO4	PO5,PO7/PSO1

BCAC0807: PROGRAMMING IN JAVA LAB

Objective: *The objective of this course is that the students will understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc. It will also provide the foundation of good programming skills by discussing key issues to the design of object-oriented programming.*

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Lab Hours
I/II	**Sample java -program execution** **Programming based on conditional statements by using java** • if statement • if else statement • switch case statement **Programming based on loops by using java** • for loop • while loop • do while loop **Programming based on Operators in java** **Programming based on Array by using java** **Programming based on String and String Buffer** **Programming based Command Line argument** **Program related to java class and object** **Programming based on constructor and method in java** • default • parameterized **Programming related to java. lang Package** **Programming based on polymorphism** • runtime polymorphism • compile time polymorphism **Programming based on keywords by using java** • static • final • super • this • abstract **Programming based on Inheritance** • single • multilevel • hybrid **Programming based on Interface and Package** **Programming based on Exception handling** **Programming based on Multithreading** **Programming based on Applet**	48

Text Book:

- Naughton Patrick, Schild Herbertz, "The Complete Reference –Java", TMH Publication, 7th edition, 2011.

Reference Books:

- Naughton Patric, Morrision Michel, "Java Hand Book", Osborne/McGraw-Hill, 5th edition, 2006.
- Balaguruswami E., "Programming with Java", TMH, 3rd edition, 2007.
- Decker & Hirshfied, "Programming Java", Vikas Publication, 2nd edition, 2000.

Focus: This Course focuses on Employability under CO1,CO2,CO5.

Outcome: After completion of course, student will be able to*:*

- CO 1: Implement Java programming concepts and develop programs based on given problem.
- CO 2: Identify the basic elements of object oriented programming and the relationships among them needed for a specific problem
- CO 3: Demonstrate how to achieve reusability using inheritance, interfaces and packages.
- CO 4: Demonstrate the use of multithreading for efficient application development.
- CO 5: Design and implement applet and GUI application programs.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3/PSO2
CO2	PO3/PSO2
CO3	PO5/PSO2
CO4	PO4/PSO1
CO5	PO5/PSO4

BCAC0808: VISUAL BASIC PROGRAMMING LAB

Objective: *The objective of this course is to help the students in finding solutions to various real life problems and converting the solutions into computer program using Visual Basic (Event Driven programming).*

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Lab Hours
I/II	**Basic of Visual Basic** • Tool Box, Tool Bar • Project Window, Form Window, Property Window and Code Window • Form Layout Window and Immediate Window • Properties of Label, Text Box, Command Buttons, Option Buttons, Frame and Check Box Controls • Events **Programming based on conditional statements** • If statement , If... Else statement , If...Else Ladder , Switch Case statement **Programming based on loops** • For...Loop , While... Loop, Do...While Loop , While...Wend , Repeat...Until **Programming based on ActiveX Controls** • Label, Text Box, Command Buttons • Option Buttons, Check Box and Frame **Programming based on user defined procedure and function** **Programming based on function-call by value and call by reference** **Programming based on In-Built functions** • String , Date **Programming based on Array** • Static array , dynamic array **Programming based on Controls** • Image Control , Picture Box , List Box and Combo Box • Hscroll Bar and Vscroll Bar • Drivet, DirList, FileListbox • Timer and Shape , Line , OLE **Programming based on run time errors handling** **Programming based on Dialog boxes** • Implementation of Msgbox( ) , Implementation of Inputbox( ) **Programming based on Menu Editor** **Programming on Data Control** **Programming based on Data Access Object(DAO)** • Implementation of insertion, deletion, updation and searching operations • Implementation of MoveFirst(), MoveLast(),MoveNext() methods **Programming based on ADODC** **Programming based on Grid Control**	48

Text Book:

- Evangelos & Petroutsos, "Mastering Visual Basic 6", BPB Publication, New Delhi, 1st edition, 2005.

Reference Books:

- Gary Cornell, "Visual Basic 6", Tata McGraw Hill, New Delhi, 20th edition, 2005.
- Noel Jerke, "Visual Basic 6 (The Complete Reference)", Tata McGraw Hill, New Delhi.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: Upon successful completion of this course, students will be able to:

- CO1: Design, create, build and debug Visual Basic applications.
- CO2: Write and apply loop structures, one and two-dimensional arrays for sorting, calculating and displaying of data.
- CO3: Know about procedures, sub-procedures, and functions to create manageable code.
- CO4: Understand event driven programming and database access.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3/PSO2
CO2	PO3/PSO2
CO3	PO5/PSO2
CO4	PO4/PSO1

BCAC0809: WEB TECHNOLOGY LAB

Objective: *The objective of this course is that students will have the knowledge to design webpage using basic html – formatting tag, linking and image tags and design web document using table creation, form creation, CSS, VBScript and JavaScript*

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Lab Hours
I/II	**Basics of HTML** • HTML head and body • Markup Tags • Linking Tags • Table creation **Form Controls** • Form Creation • Frame Creation • Form Controls- Text Field, Password Field, Multiline Text Area, Drop Down List, Check Box, Radio Buttons, Scrolled List, Reset Button and Submit Button **CSS** • Internal CSS , External CSS **Basic of VBScript** • Adding Script to HTML • VBScript Variable declaration- Global and Local Variable • VBScript Operators • Array Implementation • User defined Functions , Built in Functions **Control Statements** • If statement , If-then-else , Nested if , Select case Statement **Looping Statements** • For…Next , Do…While , Do…Until Statements **Events** • Events handling **Basic of JavaScript** • Adding Script to HTML • VBScript Variable declaration- Global and Local Variable • VBScript Operators • Array Implementation • User defined Functions , Built in Functions **Control Statements** • if statement , Switch Statement **Looping Statements** • For statement , While , Do…while **Events** • Events handling	48

Text Book:

- Bergstan, Hans, “Java Server Pages”, O’Reilly Publication, 3rdedition, 2004

Reference Books:

- Bates, Chris, “Web Programming – Building Internet Application”, Wiley-Dream tech, 2006.
- Holzener, Steven, “Inside XML”, Tech-media publication, 1stedition, 2001.
- Burdman, Jessica, “Collaborative Web Development”, Addison Wesley, 2000.

- Stalling, William, "Cryptography and networks security: Principles and Practice", Prentice Hal, 5th edition, 2011.

Focus: This Course focuses on Employability under CO1, CO2.
Outcome: After completion of course, student will be able to:
- CO1: Design webpage using basic html –formatting tag, linking and image tags.
- CO2: Design web document using table, frame creation and form creation.
- CO3: Design web document using html and adding style using CSS.
- CO4: Design interactive web document using VBScript and JavaScript.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3/PSO1
CO2	PO3/PSO2
CO3	PO1/PSO1
CO4	PO5/PSO4

BCAE0001: ADVANCED DATABASE MANAGEMENT SYSTEM

Objective: *The objective of this course is that the students will understand relational and advanced database technology for building applications for the current trend & evaluate a business situation and designing & building database applications.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction of RDBMS**: Relational Algebra, Relational Calculus, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form. **Query Optimization:** General Transformation Rules for Relational Algebra Operations, Heuristic Algebraic Optimization Algorithm, and Cost Optimization for Query Execution. **Introduction of Transaction Processing Concepts:** Transactions, Properties & States of Transactions, Read and Write Operations, System Log, Commit Point of a Transaction, Desirable Properties of Transactions, Need of Concurrency Control.	20
II	**Schedule:** Serial, Non-Serial and Conflict Serializable Schedules, Uses of Serializabilty, View Equivalence and View Serializability. **PL/SQL:** Function, Procedure, Cursor, Triggers. **Concurrency Control Techniques:** Two Phase Locking Techniques for Concurrency Control, Concurrency Control Based on Timestamp Ordering. **Deadlock:** Deadlock Handling, Deadlock Prevention, Deadlock Detection and Deadlock Recovery Techniques. **Recovery System:** Failure Classification, Storage Structure, Data Access.	20

Text Book:

- Henry F. Korth Abraham Silberschatz, "Database System Concepts", McGraw-Hill International, New Delhi, 5th.ed, 2006.

Reference Books:

- Bipin Desai, "An Introduction to Database System", West Pub. Co, 2006.
- Jeff Parkins and Bryan Morgan, "Teach Yourself SQL in 14 days".

Focus: This Course focuses on Employability under CO1,CO2,CO6.
Outcome: After completion of course, student will be able to:

- CO1: Describe the fundamental elements of relational database management systems, relational algebra and relational calculus.
- CO2: Construct the database schema by normalization.
- CO3: Understand the concept of query processing & query optimization.
- CO4: Illustrate basic issues of transaction processing and concurrency control
- CO5: Understand the concept of serial and non-serial schedules.
- CO6: Solve problems using PL/SQL programming concepts by Cursor Management, Procedure, Function and Triggers.
- CO7: Relate the concept of concurrency control and deadlock in databases..
- CO8: Understand the principles of storage structure and recovery management.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3 /PSO1, PSO2
CO2	PO1, PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2,PO3 /PSO1, PSO3
CO4	PO1 / PSO3
CO5	PO1,PO3 /PSO3
CO6	PO1,PO3 /PSO1
CO7	PO1,PO2 /PSO2
CO8	PO1,PO2 /PSO2

BCAE0002: ENTERPRISE RESOURCE PLANNING

Objective:*The objective of this course is to make students understand the business process of an enterprise, Grasp the activities of ERP project management cycle and understand the emerging trends in ERP developments.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**ERP:** Evolution and Overview of ERP, Features of ERP, Benefits of ERP, Business Modules in ERP Packages for Large and Medium Sized Manufacturing Organizations, Business Process Re-engineering (BPR), Relationship Between ERP & BPR, ERP Vender, ERP Consultants. **ERP Implementation I :** ERP Implementation Lifecycle, Implementation Methodology, ERP Selection, ERP Implementation Teams	26
II	**ERP Implementation II :** ERP Implementation Cost, Hidden Cost, Strategies for Successful Implementation, Critical Success and Failure Factors. ERP & Related Technologies, ERP and Internet, ERP and CRM, CRM- Advantages, Benefits, Challenges, ERP and SCM, Integration of ERP, CRM & SCM, Data Warehouse & Data Mining, Case Studies.	26

Text Book:

- Alexis Leon, "ERP Demystified", Tata McGraw–Hill Publishing Company limited, New Delhi, 2ndedition, 2011.

Reference Books:

- Brady, "Enterprise Resource Planning", Thomson Learning, 2005.
- Rahul V. Altekar, "Enterprise wide Resource Planning", Tata McGraw Hill, 2005.
- Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning –Concepts and Practice", PHI, 2ndedition, 2007.
- Imhoff, C. Loftis Lisa & Geiger, G. Jonathan, "Building the Customer Centric Enterprise", John Wiley & Sons, 1stedition, 2001.
- Shankar, Ravi & Jaiswal, S., "Enterprise Resource Planning", Galgotia Publications, 1stedition, 1999

Focus: This Course focuses on Employability under CO1,CO2.
Outcome: Students may be able to understand the scope of resource planning and implementation.

- CO1: Knowledge of ERP implementation cycle.
- CO2: Awareness of core and extended modules of ERP.
- CO3: Explain about Enterprise Resource Planning, Features of ERP, ERP Architecture, ERP Need Analysis and Return on Investment for ERP
- CO4: Explain ERP Life Cycle, Methodologies and Strategy of ERP and Vendor and Software Selection for ERP.
- CO5: Explain Business Process Re-engineering related to ERP, Implementation Process of ERP, Change Management of ERP, Post Implementation Support, Maintenance and Security required for ERP

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3 /PSO1, PSO2
CO2	PO1, PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2,PO3 /PSO1, PSO3
CO4	PO1 / PSO3
CO5	PO1,PO3 /PSO3

BCAE0003: SOFTWARE PROJECT MANAGEMENT

Objective: *Define and highlight importance of software project management and to prepare students for undertaking large software projects.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan. Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process, Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks. Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Network Diagrams: PERT, CPM, Bar Charts.	26
II	Dimensions of Project Monitoring & Control, Budgeted Cost for Work Scheduled (BCWS), Cost Performance Index (CPI), Schedule Performance Index (SPI), Types of Review: Inspections, Walkthroughs, Code Reviews Testing Objectives, Testing Principles, Test Plans, Test Cases, Types of Testing, Test Strategies, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators. Software Configuration Management: Software Configuration Items and tasks, Plan for Change, Change Control, Change Requests Management, Version Control, Risk Management, Risk Breakdown Structure (RBS)	26

Text Book:

- Kelkar, S. A., "Software Project Management", New Delhi: Prentice Hall India Publications.
- Cotterell, M. , "Software Project Management", New Delhi: Tata McGraw-Hill Publications.

Reference Books:

- Royce, "Software Project Management", New Delhi: Pearson Education.
- Conway, K. , "Software Project Management", New Delhi: Dreamtech Press.

Focus: This Course focuses on Employability and Skill Development

under CO1, CO2, CO5.

Outcome: After completion of course, student will be able to:

- CO1: Gain brief knowledge of Software Project Management
- CO2: Plan, build and manage project schedules and budgets using Project Professional.
- CO3: Select an excellent appropriate project approach.
- CO4: Evaluate the Project using different methods.
- CO5: Learn Software Project Management strategies.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1,PSO4
CO3	PO2/PSO3

CO4	PO1,PO2/PSO3
CO5	PO1,PO2/PSO1,PSO4

BCAE0004: MANAGEMENT INFORMATION SYSTEM & E-COMMERCE

Objective*: The objective of this course is to provide a basis of understanding to the students with reference to working of business organization through the process of management.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction**– Introduction, Meaning and role of MIS, Definition of MIS, and System approach to MIS, MIS Organization, Development of Organizational Theory, Management and Organizational Behavior. **Nature of management** – Meaning, Definition, it's nature purpose, importance & Functions, Management as Art, Science & Profession- Management as social System Concepts of management-Administration-Organization. , An overview of functions of managers: planning, organizing, staffing, leading and controlling, Coordination: essence of managership , systems approach to management, contingency approach to management. **Planning** – Meaning, need and importance, Types: missions and purposes, objectives and goals, strategies and policies, levels, advantages and limitations, procedures and rules, Programs and budgets, Steps in planning, Objectives, Management by Objectives, Strategies, policies and planning premises, Strategic planning process, Forecasting: need and techniques, Decision Making: types, process of rational decision making, and techniques of decision making.	26
II	**Organizing and staffing-** Definition of staffing, Overview of staffing function, Systems approach to human resource management, Recruitment, Selection, Placement, Promotion, Separation, Performance appraisal. **Decision making** – Types **-** Process of rational decision making & techniques of decision making Organizing Elements of organizing & processes: Types of organizations, Delegation of authority, Need, difficulties Delegation, Decentralization Staffing: Meaning & Importance, Direction, Nature, Principles Communication: Types & Importance. **Strategic Management** – Definition, Classes of Decisions, Levels of Decision, Strategy, Role of different Strategist, Relevance of Strategic Management and its Benefits, Strategic Management in India. **Recent trends of management-** Social Responsibility of Management – environment friendly management, Management of Change, Management of Crisis, Total Quality Management, Stress Management. **E-Commerce-**Types of e-commerce- B2B, B2C, C2C, and P2P, B2B service provider, e-distributor, Procurement, Importance of E-Commerce, Internet and its role in e-commerce, procedure of registering Internet domain, Tools and Services of Internet.	26

Text Book:

- Koontz, H. and Weihrich, H., "Essentials of Management", Tata McGraw Hill.

Reference Books:

- Horold Koontz and Iteinz Weibrich, "Essential of Management", McGrawhills International.
- J.N.Chandan , "Management Theory & Practice".
- K.Aswathapa, "Essential of Business Administration", Himalaya Publishing House.

Focus: This Course focuses on Employability under CO1 ,CO2.

Outcome:

- CO1: Understand the critical concepts and terminologies in information systems.

- CO2: Understand the role of IT managers in information systems planning, systems development, and hardware and software selection.
- CO3: Define problems and the current environment for existing business systems in the areas of accounting, finance, marketing, and manufacturing.
- CO4: Know the important business functions provided by typical business software such as Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP).
- CO5: Explain the components and roles of the Electronic Commerce environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO4,PO7,PO8/PSO1
CO2	PO1,PO4,PO7,PO8/PSO1
CO3	PO1,PO7,PO8/PSO1
CO4	PO1,PO7,PO8/PSO1
CO5	PO1,PO7,PO8/PSO3

BCAE0005: DIGITAL MARKETING AND TRANSFORMATION

Objective: *The objective of this course is to provide knowledge about the digital marketing and the industry trends correspondence to the concepts*.

Module No.	Content	Theory Hours
I	**Introduction to Digital Marketing** Modern Marketing- How Marketing Works, Fundamentals Channels- Awareness, Consideration & Decision Making, Building Integrated Marketing Plan, Lead Journey- From Prospect to Sales. **Website and Blogging** The Power Of Storytelling, Know Your Customer - Market And Content Research, Construct Prospective Buyer Personas & Journeys, Establishing The Content Ideation & Creation Framework, Creative Design Principles. **Content Promotion** SEO as an Art and as a Science, Ranking Algorithms, Website Audit, Optimizing Digital Assets & Metadata, Decoding Common Paid Media Platforms, Influencer Marketing, Black Hat, White Hat and Grey Hat SEO. **Email Marketing** Types of Email (Promo/Trans/NL), ESP Setup & On-boarding, Permission Marketing, Subscriber welcome plan and journey, List segmentation and Management, Personalization and Responsive design, Multivariate Testing, E-commerce Integration, Deliverability and System reputation Management, System Integrations & Automations.	21
II	**Social Media Marketing** Social Ads Type and their Design Structure, Targeting strategy and planning – Laser/Broad, Effective targeting and custom audience set-up, Campaign setup and reporting on various social platforms. **Mobile Marketing** Mobile landscapes for Marketing and Monetization, Conventional Advertising, Millennial Mobile Advertising, Versatile Promotions, Alternative focusing and promotions on Mobile, Push App and Game based promotions, Location evolution with mobile **Marketing Analytics & ROI** Key marketing engagement & ROI metrics, Primer on data science and analytics concepts, Web Traffic nuances, Multi-channel Analytics, Decoding CLV and RFM.	19

Text Book:

- Puneet Singh Bhatia, “Fundamentals of Digital Marketing”, First edition., Publication Pearson.

Reference Books:

- Ian Dodson, “The Art of Digital Marketing: The Definitive Guide to Creating Strategic”, Targeted and Measurable Online Campaigns, Publication Wiley India Pvt Ltd.
- Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, “Marketing 4.0: Moving from Traditional to Digital”, Publication Wiley India Pvt Ltd.
- Vandana Ahuja, “Digital Marketing”, 1st edition., Publication Oxford.

- Rohan Yamagishi, "Digital Marketing in Asia : A Start-Up Guide for Search Engine Marketing in APAC", Publication R. R. Bowker.

Focus: This Course focuses on Employability under CO1, CO4.

Outcome: After this course the students should be able to:

- CO1: Learn how to use new media such as mobile, search and social networking.
- CO2: Learn the measurement techniques used in evaluating digital marketing efforts.
- CO3: Understand how and why to use digital marketing for multiple goals within a larger marketing and/or media strategy.
- CO4: Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, and social media.
- CO5: Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan
- CO6: Explore the latest digital ad technologies.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO4,PO7,PO8/PSO1
CO2	PO1,PO4,PO7,PO8/PSO1
CO3	PO1,PO7,PO8/PSO1
CO4	PO1,PO7,PO8/PSO1
CO5	PO1,PO7,PO8/PSO3
CO6	PO1,PO4,PO7,PO8/PSO4

BCAE0070: ADVANCED DATABASE MANAGEMENT SYSTEM LAB

Objective: *The objective of this course is to provide the great understanding on PL/SQL to proceed with Oracle database and other advanced RDBMS concepts.*

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I/II	**Introduction to PL/SQL** • PL/SQL - data types, PL/SQL - variables, PL/SQL - operators **PL/SQL — Conditions** • IF-THEN Statement, IF-THEN-ELSE Statement, CASE Statement **PL/SQL — Loops** • WHILE LOOP Statement, FOR LOOP Statement, Reverse FOR LOOP Statement **PL/SQL — Procedures** • Creating a Procedure, Executing a Standalone Procedure, Methods for Passing Parameters **PL/SQL — Functions** • Creating a Function, Calling a Function **PL/SQL — Cursors** • Implicit & Explicit Cursors, Declaring the Cursor, Opening & Closing the Cursor **PL/SQL — Triggers** • Creating Triggers, Triggering a Trigger	24

Text Book:

- Henry F. Korth Abraham Silberschatz, “Database system concepts”, McGraw - Hill International, New Delhi,5th.edition, 2006.

Reference Books:

- Bipin Desai, “An Introduction to Database System”, West Pub. Co, 2006.
- Jeff Parkins and Bryan Morgan, “Teach Yourself SQL in 14 days”.
- Elmasri and Navathe “Fundamentals of Database Systems”, 6th edition., Addision Wesley, 2010.

Focus: This Course focuses on Employability under CO1,CO2.
Outcome: After completion of the course students will have a
- CO1: Implement the concepts of PL/SQL conditions, Loops and procedures.
- CO2: Implement the concepts of PL/SQL Functions, Cursors, and Triggers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3 /PSO1
CO2	PO1, PO3 /PSO1

BCAE0071: DIGITAL MARKETING AND TRANSFORMATION LAB

Objective: *The course is designed to provide the students with practical knowledge of broad range digital marketing, in addition to an in-depth understanding of how digital marketing is revolutionizing the current industry.*

Module No.	Content	Lab Hours
I	**Website and Blogging** ● Basic: ○ Creating websites using open source platform ○ Creating Blogs using WordPress ● Advance: ○ Creating and managing websites using Adobe Experience Manager* **Content Promotion** ● Basic: ○ Indexing & visibility optimization using open source platform ● Advance: ○ Optimization mechanism using Adobe Analytics* **Email Marketing** ● **Basic:** ○ Email set up & distribution using open source platform ● **Advance:** ○ Concepts and setup using Salesforce Marketing Cloud/Adobe Campaign Manager*	12
II	**Social Media Marketing** ● **Basic:** ○ How to be a YouTuber ● **Advance:** ○ Advance Campaign setup on social platform** **Mobile Marketing** ● **Advance:** ○ Managing In-app Push advertising* ○ Advanced flash-add management using Google play store** **Marketing Analytics & ROI** ● **Basic:** ○ Web trafficking using Google Analytics ● **Advance:** Advance analytics using Adobe Analytics*	12

Text Book:

- Ian Dodson, “The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted and Measurable Online Campaigns”, Publication Wiley India Pvt Ltd.

Reference Books:

- Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, “Marketing 4.0 : Moving from Traditional to Digital” , Publication Wiley India Pvt Ltd.
- Jeffrey K. Rohrs, “Audience: Marketing in the Age of Subscribers, Fans and Followers”, Kindle edition.
- Vandana Ahuja, “Digital Marketing 1st edition.”, Publication Oxford.

- Rohan Yamagishi, "Digital Marketing in Asia : A Start-Up Guide for Search Engine Marketing in APAC", Publication R. R. Bowker.

Focus: This Course focuses on Employability under CO1, CO5,CO6.

Outcome: By the end of the class, students will learn to:

- CO1: Discuss the key elements of a digital marketing strategy.
- CO2: Illustrate how the effectiveness of a digital marketing campaign can be measured.
- CO3: Demonstrate advanced practical skills in common digital marketing tools such asSEO, SEM, Social media and Blogs.
- CO4: Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, and social media
- CO5: Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan
- CO6: Explore the latest digital ad technologies

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO4,PO7,PO8/PSO1
CO2	PO1,PO4,PO7,PO8/PSO1
CO3	PO1,PO7,PO8/PSO1
CO4	PO1,PO7,PO8/PSO1
CO5	PO1,PO7,PO8/PSO3
CO6	PO1,PO4,PO7,PO8/PSO4

BCAE0101: INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Objective*: The objective of this course is to study the concepts of Artificial Intelligence and methods of solving problems. It also introduce the concepts of Expert Systems and machine learning.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction**: Introduction to AI, Task Domains of AI, AI Techniques, Search and Knowledge, Abstraction, Intelligent Agents and its Types. **Problem Solving**: State Space Search, Production System, Depth First Search, Breadth First Search, Heuristic Search (Hill Climbing, Best First Search and Problem Reduction). **Knowledge Representation-I**: Approaches, Types and Properties of Knowledge, Propositional Logic, Properties of Statements, Equivalence Law, Inference Laws, First Order Predicate Logic	26
II	**Knowledge Representation-II**: Properties of Wffs, Representation of Facts in First Order Predicate Logic, Conversion to Clausal Forms, Unification and Resolution, Scripts and Conceptual Dependency. **Structural Knowledge Representation**: Semantic Network, Partitioned Semantic Net, Semantic Net for Wffs and Predicate Logic, Property Inheritance Algorithm, Frame Structures and Concepts of Regular and Meta Classes With Instance & Isa Relationship. **Expert System**: Need and Justification of Expert System, Knowledge Acquisition, Inference Engine, Learning Procedure and Case Study of MYCIN.	26

Text Book:

- Rich & Knight, "Artificial Intelligence", TMH, 3rdedition, 2010.

Reference Books:

- DAN W. Patterson, "Introduction to AI & Expert Systems", PHI, 2006.
- Stuart Russell and Peter Norvig, "Artificial Intelligence-A Modern Approach", PHI, 2ndedition, 2011.
- George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", Pearson Education / PHI, 4thedition, 2006.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: Upon successful completion of this course, students will be able to:

- CO1: Get overview of Artificial Intelligence.
- CO2: Know various AI search algorithms (uninformed, informed and heuristic algorithms).
- CO3: Understand different types of Artificial Intelligence agents.
- CO4: Understand the fundamentals of knowledge representation (logic-based, frame-based, semantic nets)
- CO5: Know how to build simple knowledge-based systems.
- CO6: Get exposure about Expert system Models.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3,PSO4
CO2	PO2/PSO3
CO3	PO1,PO3/PSO2,PSO3
CO4	PO2/PSO2,PSO3
CO5	PO1 /PSO3
CO6	PO2/PSO3,PSO4

BCAE0102: SOFTWARE TESTING

Objective: *The objective of this course is that students will able to learn basic fundamentals and concepts related to software testing and learn why ,when and how perform various testing.*

Module No.	Content	Teaching Hours
I	**Review of Software Engineering**: Overview of software evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference between Verification and Validation, Test Cases, Testing Suite, Test Oracles, Impracticality of Testing All data; Impracticality of testing All Paths. **Verification:** Verification methods, SRS verification, Source code reviews, User documentation verification, Software project audit, Tailoring Software Quality Assurance Program by Reviews, Walkthrough, Inspection, and Configuration Audits. **Functional Testing:** Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique. **Structural Testing:** Control flow testing, Path testing, Independent paths, Generation of graph from program, Identification of independent paths, Cyclomatic Complexity, Data Flow Testing, Mutation Testing.	28
II	**Regression Testing:** What is Regression Testing? Regression Test cases selection, Reducing the number of test cases, Code coverage prioritization technique. **Software Testing Activities:** Levels of Testing, Debugging, Testing Techniques and their applicability, Exploratory Testing. **Automated Test Data Generation:** Test Data, Approaches to test data generation, test data generation using genetic algorithm, Test Data Generation Tools, Software Testing Tools, and Software test Plan.	24

Text Book:

- Yogesh Singh, "Software Testing", Cambridge University Press, New York, 3rd edition, 2012

Reference Books:

- Roger S. Pressman "Software Engineering – A Practitioner's Approach", Fifth edition., McGraw-Hill International edition., New Delhi, 2001.
- Marc Roper, "Software Testing", McGraw-Hill Book Co., London, ,5th edition, 2012.
- Alexis Leon, Methews Leon ,"Fundamentals of Information Technology", Vikas Publishing, New Delhi, 1999.

Focus: This Course focuses on Employability under CO1,CO2,CO3.
Outcome: After completion of course, student will be able to:

- CO1: Understand the basic concepts of software testing and tools.
- CO2: Demonstrate problem solving skills.
- CO3: Analyze requirements to determine appropriate testing strategies.
- CO4: Design various test cases for quality improvement.
- CO5: Understand different levels of software testing.
- CO6: understand concept of system testing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO11/PSO1
CO2	PO3,PO5/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO3
CO4	PO1,PO2/PSO1,PSO3
CO5	PO1,PO2/PSO2,PSO3
CO6	PO1,PO2,PO4/PSO1,PSO3

BCAE0103: CYBER SECURITY

Objective: *The course objective is to explain students the core information assurance (IA) principles and introduces the key components of cyber security network architecture, security tools and hardening techniques.*

Module No.	Content	Teaching Hours
I	**Introduction to Cyber Crime and law** A Brief History of the Internet, Recognizing and Defining Computer Crime, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, , Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000. **Introduction to Cyber Crime Investigation** Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks **Network Defense tools -I** Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls,	18
II	**Network Defense tools -II** Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System **Web Application Tools** Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra	17

Text Books:

- Nina Godbole and Sunit Belpure, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Publication Wiley.

Reference Books:

- Mike Shema, "Anti-Hacker Tool Kit", Indian edition., Publication McGraw Hill.

Focus: This Course focuses on Employability under CO2,CO4.

Outcome: After learning the course the students should be able to:

- CO1: Understand the basics of cyber security.
- CO2: Explain the basic concepts of System security.
- CO3: Understand the different investigation mechanism of cyber security.
- CO4: Explain the digital forensics in system security.
- CO5: Illustrate the laws and acts in cyber domain.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO6,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO4,PO5/PSO1,PSO4
CO3	PO1,PO3,PO4,PO6/PSO1,PSO3,PSO4
CO4	PO1,PO2,PO5/PSO1,PSO3
CO5	PO1, PO3,PO5/PSO1,PSO3

BCAE0104: DATA MINING AND WAREHOUSING

Objective*: To understand various tools of Data Mining and their techniques to solve the real time problems.*

Module No.	Content	Teaching Hours
I	**Data Warehousing:** Overview, Definition, Data Warehousing Components, Building a Data Warehouse, Warehouse Database, Mapping the Data Warehouse to a Multiprocessor Architecture, Difference between Database System and Data Warehouse. **Data Model:** Concept Hierarchy, Three-Tier Architecture, Meta Repository, Data Warehouse & OLAP Technology, Types of OLAP Servers. **Multi Dimensional Data Model**: Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, Data Marting. **Data Warehouse Process and Technology**: Warehousing Strategy, Warehouse/management and Support Processes, Warehouse Planning and Implementation, Hardware and Operating Systems for Data Warehousing, Client/Server Computing Model & Data Warehousing. Parallel Processors & Cluster Systems, Distributed DBMS implementations.	28
II	**Mining frequent Patterns**: Basic Concepts of Association Rules Mining, Apriori Algorithm, FP-Growth. Multilevel Association Rules, Multi Dimensional Association Rules. **Data Mining Cluster Analysis**: Data Types in Cluster Analysis, Categories of Clustering Methods, Partitioning Methods. Hierarchical Clustering. CURE and Chameleon. Density Based Methods -DBSCAN, OPTICS. Grid Based Methods -STING, CLIQUE. **OLAP Servers**: ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse. Warehousing applications	24

Text Book:

- Jiawei Han, Micheline Kamber, "Data Mining Concepts & Techniques", 3rd edition., Morgan Kauffmann, 2011.

Reference Books:

- M.H.Dunham , "Data Mining: Introductory and Advanced Topics", 1stedition., Pearson Education, 2003.
- Sam Anahory, Dennis Murray , "Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems", 4th edition., Pearson Education, 2009.

Focus: This Course focuses on Employability under CO2,CO3,CO4.

Outcome: *After* completion of course, student will be able to

- CO1: Understand and apply the concept of data warehouse and mining in real-life applications.
- CO2: Apply the principle algorithms used in modern machine learning.
- CO3: Apply the information theory and probability theory to get the basic theoretical results in Data Mining.
- CO4: Apply Data mining algorithms to real datasets, evaluate their performance and appreciate the practical issues involved.
- CO5: Implement clustering using various clustering methods on data set.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3,PO4/PSO1,PSO3
CO3	PO1 /PSO1
CO4	PO1 /PSO2
CO5	PO3/PSO2

BCAE0105: DISCRETE STRUCTURE & GRAPH THEORY

Objective: *The objective of this course is that students will be able to explain and apply the basic methods of discrete (non continuous) mathematics, these methods are used in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Propositions** –Logical connectives , Compound propositions , Conditional and biconditional propositions, Truth tables , Tautologies and contradictions, DeMorgan's Laws , Rules of inference, Validity of arguments. **Predicates** –Quantifiers, Universe of discourse, Logical equivalences and implications for quantified statements, Theory of inference, the rules of Universal specification and generalization Validity of arguments. **Sets** –Introduction and algebra of sets, Venn diagram, Principle of inclusion and Exclusion.	20
II	**Relation-** Introduction, types and properties. Introduction to Recurrence Relation, Linear recurrence relations with constant coefficients, Homogeneous solutions, Particular solutions, Total solutions, Generating functions, Solution of recurrence relation by the method of generating functions **Graphs** –Introduction, Sub graphs, Isomorphism, Walks, Paths, Circuits Connectedness, Components, Euler Graphs, Hamiltonian Paths and Circuits **Trees** –Properties of trees, Distance, Centers, radius and eccentricity in Tree, Rooted and Binary Trees.Incidence matrix Circuit Matrix, Path Matrix, Adjacency Matrix. Spanning tree –Finding all Spanning Trees of a Graph, Set of Fundamental Circuits, Cut Vertices, Dijkstra's Algorithm, Prim's Algorithm, Kruskal's Algorithm	20

Text Book:

- Satendra Bal Gupta, "Discrete Mathematics", 5th edition., Laxmi publication. New delhi., 2008.

Reference Books:

- D.K. Gupta, "Discrete Mathematics", KNRN Publishing, Delhi.
- Narsingh Deo, "Graph Theory", PHI, New Delhi.
- Adesh K. Pandey, S.K. Kataria, "Discrete Structure", Sons Publishing, New Delhi, 2007.

Focus: This Course focuses on Employability under CO1, CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Use logical notation to define and reason about fundamental mathematical.
- CO2: Concepts such as sets, relations, functions, and integers.
- CO3: Synthesize induction hypotheses and simple induction proofs.
- CO4: Apply graph theory models of data structures and state machines to solve problems of Connectivity and constraint satisfaction, for example, scheduling.
- CO5: Calculate numbers of possible outcomes of elementary combinatorial processes such as permutations and combinations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO3
CO2	PO1,PO3/PSO4
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3
CO5	PO1,PO2/ PSO3

BCAE0106: DESIGN & ANALYSIS OF ALGORITHMS

Objective: *The objective of this course is to study paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice. It also ensures that students understand how the worst-case time complexity of an algorithm is defined, how asymptotic notation is used to provide a rough classification of algorithms, how a number of algorithms for fundamental problems in computer science and engineering work and compare with one another, and how there are still some problems for which it is unknown whether there exist efficient algorithms, and how to design efficient algorithms.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Basic of Algorithm Analysis:** Analyzing Algorithms, Worst Case and Average Case Analysis, Asymptotic Notations (Omega, Theta, Big "Oh", Little "Oh", Little Omega). **Recurrences:** Substitution Method, Recursion Tree Method, Master Method. **Divide and Conquer Method:** Binary Search, Merge Sort and Quick Sort. **Sorting in Linear Time:** Radix Sort and Insertion Sort. **Graph Algorithms:** Elementary Graph Algorithms, Breadth First Search, Depth First Search. **Minimum Spanning Tree:** Kruskal's Algorithm, Prim's Algorithm,	20
II	**Single Source Shortest Path:** Dijkstra's Algorithm. **All Pair Shortest Path:** Floyd-Warshall Algorithm, Traveling Salesman Problem. **Advanced Data Structures:** B–Trees. **Dynamic Programming:** Elements of Dynamic Programming, Matrix Chain Multiplication, Longest Common Subsequence. **Greedy Method:** Knapsack Problem, Huffman Coding. **Advanced Data Structures:** AVL Tree, 2-3 Tree,2-3-4 Tree	20

Text Book:

- Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, (2010), "Introduction to Algorithms", Printice Hall of India, 5th edition.

Reference Books:

- RCT Lee, SS Tseng, RC Chang and YT Tsai, "Introduction to the Design and Analysis of Algorithms", McGraw Hill, 2006.
- E. Horowitz & S. Sahni, "Fundamentals of Computer Algorithms", Galgotia Publication Pvt. Ltd, 2007.
- Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms", Pearson Education, 2008.
- D. E. Knuth, "The Art of Computer Programming", Addison Wesley, 3rd edition, 1998.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome :

- CO1. Analyze worst-case running times of algorithms using asymptotic analysis.
- CO2. Apply the sorting algorithms (Insertion, Merge, Quick and Radix Sort) to solve real life applications.
- CO3. Apply the divide-and-conquer paradigm (Binary Search) and explain when an algorithmic design situation calls for it.
- CO4. Analyze the major graph algorithms (Depth First Search and Breath First Search).
- CO5. Understand the single source and all pair shortest path problems. Solve it using existing algorithms and analyze its time complexity.

- CO6. Understand the dynamic-programming paradigm to solve Matrix Chain Multiplication and Longest Common Subsequence problems.
- CO7. Illustrate the greedy paradigm (Knapsack Problem and Huffman Coding) and explain when an algorithmic design situation calls for it.
- CO8. Compare the difference between different data structures. Pick an appropriate data structure for a design situation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 / PSO3
CO2	PO2/PSO1
CO3	PO3/PSO1,POS2
CO4	PO1,PO4/POS1,PSO3
CO5	PO3/PSO2
CO6	PO2,PO3/PSO3
CO7	PO2,PO5/PSO2
CO8	PO1,PO5/PSO1,PSO3

BCAE0201: PROGARMMING IN ADVANCED JAVA

Objective: *The objective of this course is to cover the basics of creating APIs as well as allow students to explore the Java Abstract Programming Interface (API) and Java Collection Frame work through programming assignments.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Collection Frame Work:** List Interface, Set Interface, Stored Set Interface. Array List Class, Linked List Class, Hash Set Class, Linked Hash Set Class, Accessing a Collection Vis Iterator **I/O Files in Java:** Stream: Byte Stream Classes, Character Stream Classes, File IO basics, File operations Creating file Reading file, Writing file. **GUI Programming:** Introduction to Applet, Applet Lifecycle, Introduction to AWT Programming, Basic GUI Components((Labels, Buttons, Checkboxes, Checkbox Group, Choices, Text Fields, Text Areas, Lists, Scrollbars, Panels, Windows, Menus, Menu bars), Layout Managers. **Graphical User Interface**: Event Driven Programming in Java, Event Handling Process ,Event Handling Mechanism , The Delegation Model of Event Handling, Event Classes, Event Sources, Event Listeners	20
II	**Swing:** Swing Architecture, Introduction to Swing Component, Comparison of Swing Component and AWT Component, Creating a Swing Applet and Application. Swing's Architecture & background, Container and Frame, Basic Swing Programming: Swing lists, Swing tables, Swing tree. **JDBC Connectivity**: Types of Drivers, The Connectivity Model, JDBC/ODBC Bridge Communicating with Database **Introduction to Servlets**: Need for Servlets, Introduction to Servlets, The Javax, Servlet Package, Life Cycle of a Servlet, Http Servlet Request, Http Servlet Response, Deploying Servlets and Servlet Contexts, Accessing a Servlet Using an HTML Page. **Introduction to JSP**: Need for JSP, The JSP Request Response Class; Connectivity JSP Pages to Data Base.	20

Text Book:

- Naughton Patrick, Schild Herbertz, "The Complete Reference –Java", TMH Publication, 7th edition, 2011.

Reference Books:

- Naughton Patric, Morrision Michel, "Java Hand Book", Osborne/McGraw-Hill, 5th edition, 2006.
- Balaguruswami E, "Programming with Java", TMH, 3rd edition, 2001.
- Decker & Hirshfied, "Programming Java", Vikas Publication 2nd edition, 2000.

Focus: This Course focuses on Employability under CO1,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Understand the key concepts of object oriented
- programming and have an ability to design OO programs
- and appreciate the techniques of good design;
- CO2: Understand advanced features of Java
- CO3: Analyze complex programming problems and optimize the solution
- CO4: Apply an understanding of problems and their solutions using JAVA

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO7/PSO2
CO2	PO1,PO3,PO7/PSO1
CO3	PO1,PO7/PSO1
CO4	PO1,PO3,PO5/PSO4

BCAE0202: INTRODUCTION TO DISTRIBUTED SYSTEM

Credits: 04 **L–T–P: 4–0–0**

Objective: *To understand the fundamental knowledge in distributed computing.*

Module No.	Content	Teaching Hours
I	**Introduction to Distributed System**: Introduction to Distributed Systems and Design Issues, Distributed System Characteristics, **Systems Models:** Architectural Model, Fundamental Model, Examples of Distributed System, **Clock Concept in Distributed System:** Limitation of Distributed System, Lamport Clock & Vector Clock , Causal Ordering of Events **Distributed Mutual Exclusion**: Classification & Requirements for mutual exclusion, Performance Matrices for Measurement, Non-Token based algorithms- Lamport Algorithm, Ricart-Agrawala Algorithm, Token Based Algorithm-Suzuki-Kasmi Algorithm **Distributed Deadlock**: Distributed Deadlock Handling Strategies and Issues, Centralized Deadlock Detection-Ho Ramamurthy Algo, Distributed Deadlock Detection- Path Pushing Algo:-Obermarek et al. Algo Edge chasing Algorithm: - Chandy Mishra Haas algo.	26
II	**Agreement Problem:** Classification of Agreement Protocols, Byzantine Agreement Problem, Solution to Byzantine Agreement Problem:- lamport , pease et al. Algo. **Communication in Distributed System**: RMI, RPC **Distributed File System:** Introduction to distributed file system, **Failure Recovery:** Failure Recovery-Backward & Forward Recovery, Recovery in Concurrent Systems-Synchronous Algo:- The Checkpoint Algo., Asynchronous Algorithm for Check pointing and recovery **Distributed Shared Memory:** Design issues in Distributed Shared Memory, Algorithm for Implementation of DSM	26

Text Book:

- B. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson edition.

Reference Books:

- A. Singhal & Shivaratri, "*Advanced Concept in Operating Systems*", McGraw Hill.
- C. Tannenbaum "*Distributed Systems: Principles and Paradigms*", Pearson Education, 2004.

Focus: This Course focuses on Employability under CO1, CO2,CO6.

Outcome:

- CO1: Understand the concepts and issues related to distributed systems.
- CO2: Design and develop the programs for distributed environment.
- CO3: Manage performance, reliability and other issues while designing in distributed environment.

- CO4: List the principles of distributed systems and describe the problems and challenges associated with these principles.
- CO5: Understand Distributed Computing techniques, Synchronous and Processes.
- CO6: Apply Shared Data access and Files concepts.
- CO7: Design a distributed system that fulfills requirements with regards to key distributed systems properties.
- CO8: Understand Distributed File Systems and Distributed Shared Memory.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2,PO3/PSO1,PSO2
CO4	PO1,PO2/PSO1,PSO2
CO5	PO1,PO2/PSO1
CO6	PO1,PO2,PO4/PSO1
CO7	PO3/PSO2
CO8	PO4/PSO2

BCAE0203: INTRODUCTION TO CLOUD COMPUTING

Objective: *The objective of this course is to enhance cloud computing environment, to study various platforms & to study the applications that uses cloud computing.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Overview of Computing Paradigm** – Recent trends in Computing Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing Evolution of cloud computing, Business driver for adopting cloud computing. **Introduction to Cloud Computing Cloud Computing** – (NIST Model) Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers Properties, Characteristics & Disadvantages Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing Role of Open Standards. **Cloud Computing Architecture** – Cloud computing stack Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used	18
II	Role of Web services Service Models (XaaS) Infrastructure as a Service(IaaS) , Platform as a Service(PaaS), Software as a Service(SaaS) Deployment Models Public cloud, Private cloud, Hybrid cloud, Community cloud **Infrastructure as a Service (IaaS)** – Introduction to IaaS, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine (VM) Resource Virtualization Server. **Cloud Security** – Infrastructure Security Network level security, Host level security, Application level security Data security and Storage Data privacy and security Issues	17

Text Book:

- Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011.

Reference Books:

- Nikos Antonopoulos, Lee Gillam, "Cloud Computing-Principles, Systems and Applications", Springer, 2012.
- Ronald L. Krutz, Russell Dean Vines, "Cloud Security- A Comprehensive Guide to Secure Cloud Computing", Wiley-India, 2010.
- Anthony T. Velte, "Cloud Computing: A Practical Approach", Tata McGraw Hill, 2009.

Focus: This Course focuses on Employability under CO2,CO5.

Outcome: After completion of course, student will be able to:

- CO1: To understand the basic concept of cloud computing environments.
- CO2: Gain Knowledge of cloud building blocks and technologies.
- CO3: To understand cloud computing security issues and virtualization techniques.
- CO4: Identify the known threats, risks, vulnerabilities and privacy issues associated with Cloud based IT services
- CO5: Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost

- CO6: Identify the Challenges in managing heterogeneous clouds.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO5/PSO5
CO2	PO3/PSO4
CO3	PO3,PO5/PSO4
CO4	PO3,PO5/PSO4
CO5	PO3/PSO2
CO6	PO2/PSO4

BCAE0204: INTRODUCTION TO BIG DATA

Objective: *This course will cover the basic concepts of big data, methodologies for analyzing structured and unstructured data with emphasis on the relationship between the Data Scientist and the business needs.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Big Data** – Big Data and its Importance, Challenges of Conventional Systems, Four V's of Big Data, Drivers for Big Data, Introduction to Big Data Analytics, Big Data Analytics applications, Intelligent data analysis Nature of Data - Analytic Processes and Tools - Analysis vs Reporting. **Introduction To Streams Concepts** – Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream. **Big Data Technologies-I** - History of Hadoop, The Hadoop Distributed File System, Components of Hadoop,	20
II	**Big Data Technologies-II** - Analyzing the Data with Hadoop, Scaling Out-Hadoop Streaming, HDFS basics, Developing a Map Reduce Application, How Map Reduce Works. **Big Data Tools and Techniques** - Applications on Big Data Using Pig, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators in Pig. **Introduction of Hive** - HiveQL, Querying Data in Hive, User-Defined Functions.	20

Text Book:

- Jason Kolb, Jeremy Kolb, "The Big Data Revolution", 2013.

Reference Books:

- WAGmob, "Big Data and Hadoop", 1.5 edition, 2013.

Focus: This Course focuses on Employability under CO1 ,CO2,CO3,CO5.

Outcome: After completion of the course, the student will be:

- CO1: Understand the concepts and challenges of big data.
- CO2: Apply existing technology to collect, manage, store, query, and analyze the big data.
- CO3: Apply job scheduling of various applications and resource management using Hadoop and Yarn.
- CO4: Apply the data summarization, query, and analysis of big data using pig and hive.
- CO5: Design the regression model, cluster and decision tree of big data.
- CO6: Experiment with hands-on experience in large-scale analytics tools to solve big data problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO5/PSO5
CO2	PO3/PSO4
CO3	PO3,PO5/PSO4
CO4	PO3,PO5/PSO4
CO5	PO3/PSO2
CO6	PO2/PSO4

BCAE0205: INTRODUCTION TO INTERNET OF THINGS

Objective: *The objective of the course is to vision and Introduction to IoT and understands State of the Art – IoT Architecture.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	
I	**IoT Architecture-State of the Art –** Introduction, State of the art, **Architecture Reference Model-** Introduction, Reference Model and architecture, IoT reference Model **M2M and IoT Technology Fundamentals-** Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management **M2M to IoT – A Market Perspective–** Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.	26
II	**M2M to IoT-An Architectural Overview–** Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. **IoT Reference Architecture-** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints-** Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. **Industrial Automation-** Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things	26

Text Books:

- Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st edition., Academic Press, 2014.

Reference Books:

- Vijay Madisetti and Arshdeep Bahga , "Internet of Things (A Hands-on-Approach)", 1st edition., VPT, 2014.
- Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st edition., Apress Publications, 2013.

Focus: This Course focuses on Employability under CO1 ,CO2.

Outcome: By the end of the class, students will learn to:

- CO1: Understand the vision of IoT from a global context.
- CO2: Determine the Market perspective of IoT.
- CO3: Use of Devices, Gateways and Data Management in IoT.
- CO4: Building state of the art architecture in IoT.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO2 /PSO4
CO3	PO5/PSO2
CO4	PO11/PSO2

BCAE0206: .NET FRAMEWORK USING VB .NET

Objective: *The course objective is to get familiarize with Microsoft VB.Net technologies. The VB.Net course is designed to understand the different concepts and features of .NET coding, debugging and developing of Console, Windows and web applications in terms of Single and Multi-Tier architecture. This course emphasis on the fundamentals like language syntax, data and file structures, input/output devices, and files as well as advance feature such as Windows, Web services, Exception Management, Component Programming etc. which helps the students of design applications with rapid development approach.*

Credits: 03 L–T–P: 3–0–0

Module No.	Content	Teaching Hours
I	**Introduction to .Net Framework:** Architecture of .Net Framework, Features of .Net, Advantages of .Net, Common Language Runtime, Common Type System, Common Language Specification, MSIL. **Introduction to Visual Basic.Net IDE:** Creating a project, Types of project in .Net, Exploring and coding a project, Solution explorer, toolbox, properties window, Output window, Object Browser. **VB.Net Programming Language**: Similarities and Differences with Visual Basic, Variables, Comments, Data Types, Working with Data Structures – Arrays, Array Lists, Enumerations, Constants, Structures. **Object Oriented Features:** Classes and Objects, Access Specifiers: Private, Public and Protected, Building Classes, Reusability, Constructors, Inheritance, Overloading, Overriding, Creating and Using Namespaces.	20
II	**VB.Net Programming Language:** Introduction to procedures, calling procedures, argument passing mechanisms, scope of variable, conditional statement, Loops, Nesting of Loops, MsgBox and Input Box. **GUI Programming:** Introduction to Window Applications, Using Form – Common Controls, Properties, Methods and Events. Interacting with controls - Textbox, Label, Button, Listbox, Combobox, Checkbox, Picture Box, Radio Button, Panel, scroll bar, Timer, ListView, TreeView, toolbar, Status Bar. Dialog Controls, Creating and Using MDI applications, Toolbar, Status Bar, Creating custom controls, Creating Menus. **Introduction to ADO:** ADO vs ADO.Net, ADO.Net data namespaces, ADO.Net Object Model, Accessing data from Server Explorer, Creating Connection, Command, Data Adapter, Data Reader and Data Set with OLEDB and SQLDB, Data Binding.	20

Text Book:

- Kogent, “Visual Basic Programming Black Book”, Kogent Learning Solutions, Wiley India, 2010.
- Michael Halvorson, “Visual Basic- Step By Step”, PHI, 2010.

Reference Books:

- Evangelos Petroutsos, “Mastering Microsoft Visual Basic”, Wiley Publications, 2010.
- Wrox, “Beginning Visual Basic”, 2010.

Focus: This Course focuses on Employability under CO1, CO2,CO6.

Outcome: After completion of course, student will be able to:

- CO1: Gain an understanding of the Microsoft .NET architecture.
- CO2: Gain a working knowledge of the VB.Net programming language and Learn how to build object-oriented applications using VB.Net.
- CO3: Gain a comprehensive understanding of the philosophy and architecture of VB.Net programming

- CO4: Attain a detailed working knowledge of VB.Net implicit types, object initializers, delegates, anonymous types & methods, extension methods and many more.
- CO5: Acquire a working knowledge of creating and rich console, windows and web aplications using the .NET Framework 4.0 and Visual Studio 2010.
- CO6: Configure and deploy a Microsoft Console and Windows application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO2 /PSO4
CO3	PO3,PO5/PSO2
CO4	PO4/PSO2
CO5	PO4/PSO2
CO6	PO4,PO5/PSO2

BCAE0270: ADVANCED JAVA LAB

Objective: To implement various object-oriented programming concepts related to the java language by using Applet, Swing and JDBC,

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I/II	**Programs Based on the Concepts Collection Framework:** ● Generic Classes and Collection API. **Programs Based on the Concepts of Applet:** ● Write a program using Applet to display message in the Applet ● Write a program using Applet for configuring Applets by passing parameters. ● Write programs for using Graphics class -to display basic shapes and fill them -draw different items using basic shapes -set background and foreground colors **Programs Based on the Concepts of Event Handling:** ● Write a Java Program to demonstrate Action event ● Write a Java Program to demonstrate Mouse events **Programs Based on the Concepts of AWT and Swing Component:** ● Applet Programming, With GUI Development using AWT and Swings Handling Events On GUI Components. **Programs Based on the Concepts of JDBC:** ● Write Program to perform database operation ● Handling Database Connectivity With Java. **Programs Based on the Concepts of Servlet:** ● Write a program to demonstrate Basic Servlet ● A simple servlet that just generates plain text **Programs Based on the Concepts of JSP:** ● Write a program to demonstrate basic JSP example. ● Program for Database Operation in JSP.	24

Text Book:

- Naughton Patrick, Schild Herbertz, “The Complete Reference –Java”, TMH Publication, 7th edition, 2011.

Reference Books:

- Naughton Patric, Morrision Michel, “Java Hand Book”, Osborne/McGraw-Hill, 5th edition, 2006.

Focus: This Course focuses on Employability under CO1 ,CO2.

Outcome: After completion of course, student will be able to:

- CO1: Use the Java SDK environment to create, debug and run simple Java programs.
- CO2: Create Java application programs using sound OOP practices (e.g., interfaces and APIs)
- CO3: Able to develop and deploy Applet in java.

- CO4: Create dynamic web pages, using Servlets and JSP.
- CO5: Learn to access database through Java programs, using Java Data Base Connectivity (JDBC)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2/PSO3
CO3	PO1,PO3/PSO1,PSO3
CO4	PO2,PO3/PSO2
CO5	PO1,PO3/PSO1,PSO2

BCAE0271: INTRODUCTION TO BIG DATA LAB

Objective: *The objective of this course is that students will have the knowledge to optimize business decisions and create competitive advantage with Big Data analytics.*

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I/II	**Basics of Hadoop** • Perform setting up and Installing Hadoop in its two operating modes: Pseudo distributed & Fully distributed. • Use web based tools to monitor your Hadoop setup. **Implement the following file management tasks in Hadoop**: • Adding files and directories, Retrieving files, Deleting files • Benchmark and stress test an Apache Hadoop cluster **Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm** • Find the number of occurrence of each word appearing in the input file(s) • Performing a MapReduce Job for word search count (look for specific keywords in a file) **Introduction to Hive** • Use of primitive data types & collection data types **Hive Query Language** • DDL (Data Definition Language) Statement • DML (Data Manipulation Language) Statements	24

Text Book:

- Jason Kolb, Jeremy Kolb, “The Big Data Revolution”, 2013.

Reference Books:

- WAGmob , “Big Data and Hadoop”, 1.5 edition, 2013.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of the course, the student will be

- CO1: Familiar with the solution of Big Data
- CO2: To implement the basic knowledge of design of Hadoop.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO5/PSO4
CO2	PO1,PO5/PSO3

BCAE0272: VB .NET PROGRAMMING LAB

Objective: *The student will use Visual Basic.Net to build Windows applications using structured and object-based programming techniques. Students will be exposed to the following concepts and/or skills at an introductory concepts level:*

- *Analyze program requirement.*
- *Design/develop programs with GUI interface.*
- *Code programs and develop interface using Visual Basic .Net*
- *Perform tests, resolve defects and revise existing code.*

Credits: 01 L–T–P: 0–0–2

Module No.	Content	Lab Hours
I/II	• Understanding about VB .NET Integrated Development Environment: How to create a project, Various types of project developed in VB .NET, Exploring and Coding a project, Solution explorer, Toolbox, Properties window, Output window, Object Browser. • Programming in VB .NET: Develop programs related to Data Structures – Arrays, Array Lists, Enumerations, Constants, and Structures. • Develop programs related to Procedures, Calling procedures, Argument passing mechanisms, Scope of variable, Conditional statement, Loops, Nesting of Loops, MsgBox and Input Box. • GUI Programming: Develop various VB .NET Window Applications Using Windows Form – Common Controls, Properties, Methods and Events, Textbox, Label, Button, Listbox, Combobox, Checkbox, Picture Box, Radio Button, Panel, scroll bar, Timer, ListView, TreeView, toolbar, Status Bar. Dialog Controls, Creating and Using MDI applications, Toolbar, Status Bar, Creating custom controls, Creating Menus. • Programming using ADO .NET: Develop various Database Windows applications using Connection, Command, Data Adapter, Data Reader and Data Set.	24

Text Book:

- Kogent, "Visual Basic Programming Black Book", Kogent Learning Solutions, Wiley India, 2010.
- Michael Halvorson, "Visual Basic 2010 Step By Step", PHI, 2010.

Reference Books:

- Evangelos Petroutsos, "Mastering Microsoft Visual Basic", Wiley Publications, 2010.
- Wrox, "Beginning Visual Basic", 2010.

Focus: This Course focuses on Employability under CO1,CO2,CO6,CO7 .

Outcome:

- CO1: Logic Development to analyze the problem and design optimized solution using VB.Net.
- CO2: Create programs using Visual Basic (VB) code and .NET Framework classes.
- CO3: Be aware of the latest developments in VB and .NET.
- CO4: Recognize, describe and use the .NET Framework and its various classes.
- CO5: Develop applications of various categories like console, windows and web including the designing of windows and web services in the .NET.
- CO6: Apply data access technologies from within VB.NET.
- CO7: Develop simple to intermediate application using .NET, individually and as a team member.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2/PSO3
CO3	PO1,PO3/PSO1,PSO3
CO4	PO2,PO3/PSO2
CO5	PO1,PO3/PSO1,PSO2
CO6	PO2/PSO3
CO7	PO1,PO3/PSO1

BCAJ0950: MINI PROJECT - I

Objective: *To implement a computer language to build a software system to reduce the paper work*

Semester IV

Credits: 01 **L–T–P-J: 0–0–**

Module No.	Content	Lab Hours
I	Students are required to develop a real time application project comprising of minimum 1000 LOC on any platform in a modular structure. The development of the project must consist of the following : Project Planning – Schedule and Activity Estimation using MS Project 2000 SRS in IEEE 830-1998 format Process Framework for development Software Design Document as per IEEE-1016 Interfaces Detail and Component Level Design Test Cases development as per the stated Software requirement, which is further to be tested on any CASE tool. In order to obtain creativity, it is required that, the software must have minimal use of library/ library functions of respective language/ package	24

Focus: This Course focuses on Employability under CO1, CO2.

Outcome:

- After completing the project, the students should gain an insight into the development process of real projects and understand the concepts of software products and software processes.

BCAJ0951: MINI PROJECT - II

Objective: *To implement a computer language to build a software system to reduce the paper work*

Semester V

Credits: 01 **L–T–P-J: 0–0–**

Module No.	Content	Lab Hours
I	Students are required to develop a real time application project comprising of minimum 1000 LOC on any platform in a modular structure. The development of the project must consist of the following : Project Planning – Schedule and Activity Estimation using MS Project 2000 SRS in IEEE 830-1998 format Process Framework for development Software Design Document as per IEEE-1016 Interfaces Detail and Component Level Design Test Cases development as per the stated Software requirement, which is further to be tested on any CASE tool. In order to obtain creativity, it is required that, the software must have minimal use of library/ library functions of respective language/ package	24

Focus: This Course focuses on Employability under CO1, CO2.

Outcome:

- After completing the project, the students should gain an insight into the development process of real projects and understand the concepts of software products and software processes.

BCAJ0971: MAJOR PROJECT

Objective: *To implement a computer language to build a software system to reduce the paper work*

Semester VI

Credits: 06 **L–T–P-J: 0–0–**

Module No.	Content	Lab Hours
I	Students are required to develop a real time application project comprising of minimum 1000 LOC on any platform in a modular structure. The development of the project must consist of the following : Project Planning – Schedule and Activity Estimation using MS Project 2000 SRS in IEEE 830-1998 format Process Framework for development Software Design Document as per IEEE-1016 Interfaces Detail and Component Level Design Test Cases development as per the stated Software requirement, which is further to be tested on any CASE tool. In order to obtain creativity, it is required that, the software must have minimal use of library/ library functions of respective language/ package	48

Focus: This Course focuses on Employability under CO1, CO2.

Outcome:

- After completing the project, the students should gain an insight into the development process of real projects and understand the concepts of software products and software processes.

COURSE STRUCTURE

B.TECH.

COMPUTER SCIENCE & ENGINEERING

Specialization

in

Cloud Computing & Virtualization

Under

Choice Based Credit System (CBCS)

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Program Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals, researchers or entrepreneurs, for developing sustainable solutions.

PEO2: Attain positions of leadership in an organization and /or on teams.

PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Program Specific Outcomes (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.

PSO2: Design and develop hardware and software interfaces along with latest tools and technology to meet the needs of industry.

PSO3: Analyze the algorithmic principles, theory of computation, applied database management systems and mathematical foundations for the modeling and design of computing systems.

PSO4: Apply knowledge to provide innovative solutions to existing problems and identify research gaps.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics and science, with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE.

PO2: Problem Analysis: Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of solutions: Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations.

PO4: Conduct Investigations of Complex problems: Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development

PO8: Ethics: Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

PO12: Life-Long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change.

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BPHS0001	Engineering Physics	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication – I	2	0	0	2	2
4.	BEEG0001	Electrical Engineering	3	1	0	4	4
5.	BCSG0001	Python Programming	4	1	0	5	5
6.	BCSC0600	Introduction to Open Source Software & Open Standards	2	0	0	2	2
PRACTICALS							
7.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
8.	BELH0801	English Language Lab – I	0	0	2	1	2
9.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
10.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
11.	BCSG0800	Python Programming Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**26**	**31**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BCSC 1001	C PROGRAMMING	3	1	0	4	4
3.	BELH0002	English Language Skills for Communication – II	2	0	0	2	2
4.	BECG0001	Electronics Engineering	3	1	0	4	4
5.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
6.	BCSC0601	Web Programming through PHP	3	0	0	3	3
PRACTICALS							
7.	BCSC 0800	C PROGRAMMING Lab	0	0	2	1	2
8.	BELH0802	English Language Lab – II	0	0	2	1	2
9.	BECG0800	Electronics Lab I	0	0	2	1	2
10.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1	2
11.	BCSC0800	Web Programming Lab	0	0	2	1	2

		TOTAL	17	4	10	26	31

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BCSC1001	Computer Programming	3	1	0	0	4	4	
2.	BCSC0002	Object Oriented Programming	3	0	0	0	3	3	Computer Programming
3.	BCSC0003	Database Management System	3	0	0	0	3	3	
4.	BCSC0004	Operating Systems	3	0	0	0	3	3	
5.	BCSC0005	Computer Organization	3	0	0	0	3	3	
6.	BCSC0006	Data Structures & Algorithms	3	1	0	0	4	4	Computer Programming
7.	BCSC0007	Introduction to Microprocessors	3	0	0	0	3	3	Computer Organization
8.	BCSC0008	Computer Networks	3	1	0	0	4	4	
9.	BCSC0009	Software Engineering	3	0	0	0	3	3	
10.	BCSC0010	Discrete Mathematics	3	1	0	0	4	4	
11.	BCSC0011	Theory of Automata & Formal Language	3	1	0	0	4	4	
12.	BCSC0012	Design and Analysis of Algorithm	3	1	0	0	4	4	Data Structures & Algorithms
13.	BCSC0600	Introduction to Open Source Software & Open Standards	2	0	0	0	2	2	
14.	BCSC0601	Web Programming through PHP	3	0	0	0	3	3	Computer Programming
15.	BCSC0014	Applied Database Management System	4	0	0	0	4	4	
PRACTICALS									
1.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
2.	BCSC0801	Object Oriented Programming Lab	0	0	2	0	1	2	Programming Lab
3,	BCSC0802	Database Management System Lab	0	0	2	0	1	2	
4.	BCSC0803	Operating Systems Lab	0	0	2	0	1	2	
5.	BCSC0804	Computer Organization Lab	0	0	2	0	1	2	
6.	BCSC0805	Data Structures & Algorithms Lab	0	0	2	0	1	2	Programming Lab

7.	BCSC0806	Microprocessors Lab	0	0	2	0	1	2	Computer Organization Lab
8.	BCSC807	Design and Analysis of Algorithms	0	0	2	0	1	2	
9.	BCSC0900	Web Programming Lab	0	0	2	0	1	2	Programming Lab
10.	BCSC0808	Applied Database Management System	0	0	2	0	1	2	
		Total	**45**	**6**	**20**	**0**	**61**	**71**	

Program Elective (Only for Specialization Programme)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Cloud Computing & Virtualization									
THEORY									
1.	BCSE0501	Introduction to IT Infrastructure Landscape	2	0	0	0	2	2	
2.	BCSE0502	Introduction to Virtualization and Cloud Computing	3	0	0	0	3	3	
3.	BCSE0503	Cloud Computing Architecture & Deployment Models	3	0	0	0	3	3	
4.	BCSE0508	Cloud and Business Process Management	3	0	0	0	3	3	
5.	BCSE0509	Cloud Security, Backup & Disaster Recovery	3	0	0	0	3	3	
6.	BCSE0510	Container Orchestration and Infrastructure Automation	3	0	0	0	3	3	
7.	BCSE0511	Devops	3	0	0	0	3	3	
PRACTICALS									
1.	BCSE0531	Virtualization Lab	0	0	2	0	1	2	
2.	BCSE0532	Cloud Deployment Lab	0	0	2	0	1	2	
3.	BCSE0536	Cloud and Business Process Management Lab	0	0	2	0	1	2	
4.	BCSE0537	Cloud Security, Backup & Disaster Recovery Lab	0	0	2	0	1	2	
5.	BCSE0538	Container Orchestration and Infrastructure Automation Lab	0	0	2	0	1	2	
6.	BCSE0539	DevOps Lab	0	0	2	0	1	2	
Total			**20**	**0**	**12**	**0**	**26**	**32**	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BCSJ0950	Mini Project – I	0	0	0	0	2	0	
2.	BCSJ0951	Mini Project – II	0	0	0	0	2	0	
3.	BCSJ0971	Project – Part I	0	0	0	0	3	0	
4.	BCSJ0972	Project – Part II	0	0	0	0	8	0	
5.	BCSJ0991	Industrial Training	0	0	0	0	2	0	
		TOTAL	**0**	**0**	**0**	**0**	**17**	**0**	

Mandatory Non Graded Course

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
5.	BCHM0202	Environmental Studies	2	0	0	0	2	2	
6.	BELM0001	Introduction to Bhagavad Gita	2	0	0	0	2	2	
		TOTAL	**12**	**0**	**0**	**0**	**0**	**12**	

Humanities and Social Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purposes – I	2	0	0	0	2	2	
4.	BELH0004	English for Professional Purposes – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAH0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	8	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	8	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG0001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BCSG0001	Python Programming	4	1	0	0	5	5	
PRACTICALS									
5.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
6.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
7.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
8.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
9.	BCSG0800	Python Programming Lab	0	0	2	0	1	2	

BCSG0001: PYTHON PROGRAMMING

Objective: *This course introduces the solving of mathematical problems using Python programming using OO concepts and its connectivity with database.*

Credits:05 **L-T-P-J:4-1-0-0**

Module No.	Content	Teaching Hours
I	Introduction to Python: Introduction and Basics; Setting up path Python Data Variables & Operators: Data Variables and its types, id () and type () functions, Coding Standards; **Control Structures:** if-else, elif, Nested if, Iteration Control structures, Break, Continue & Pass; **String Manipulation:** Accessing Strings, Basic Operations, String slices Function and Methods. **Lists:** Introduction, Accessing list, Operations, Working with lists, Function and Methods. **Tuple:** Introduction, accessing tuples , Operations, Working, Functions and Methods. **Dictionaries:** Introduction, accessing values in dictionaries, Working with dictionaries, Properties ,Functions.	22
II	**Functions:** Defining & Calling a function, Passing arguments to functions – Mutable & Immutable Data Types, Different types of arguments, Recursion, Scope of variables; **Modules and Packages:** User-defined modules and Standard Library: random, numpy, scipy, sys, Math Module, String Module, List Module, Date & Time Module, Regular Expressions: match, search, replace; **Input-Output:** Printing on screen, reading data from keyboard, Opening and closing file, Reading and writing files, Functions. **Exception Handling:** Exception, Exception Handling, except clause, try? finally clause, User Defined Exceptions. Basics of Python for Data Analysis, Introduction to series and dataframes& Python using Pandas.	22

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focus on Employability under CO1, CO2,CO3,CO5,CO7.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of Python Programming.
- CO2: Apply the concepts of control structures and string manipulations of python programming.
- CO3: Understand the use of data structures available in Python List, Tuple and Dictionary.
- CO4: Experiment user-defined functions and access built-in functions.
- CO5: Experiment user-defined modules and access built-in modules- math, random, string, date, time, date time.
- CO6: Develop the programs using the concept of File Handling.
- CO7: Develop programs based on Exceptional Handling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO2/PSO4
CO2	PO4/PSO1
CO3	PO5/PSO4
CO4	PO5,PO7/PSO1
CO5	PO2,PO8/PSO4
CO6	PO3,PO10/PSO2
CO7	PO5,PO9/PSO1

BCSC1001: COMPUTER PROGRAMMING

Objective: *To impart adequate knowledge on the need of problem solving techniques and develop programming skills to implements applications using the concepts of C Language. Also by learning the programming constructs they can easily switch over to any other language in future.*

Credits:05 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Generation of Programming Languages:** Low, Assembly, High and 4GL. **Language Processors:** Compiler, Interpreter, Assembler, Linker and Loader. **Algorithm:** Introduction, Features, Different Ways of stating Algorithms. **Flow Chart:** Introduction, Standard, Guidelines, Advantages and Limitations of using Flowcharts. **Basics of C:** Overview, Structure of a C program, Identifier, Keywords, Variables, Data types, Formatted Input and output. **Operators and Expression:** Assignment, Unary, Arithmetic, Relational, Logical, Bitwise, Conditional, Special operators and their precedence & Associativity. IEEE representation of data types like float & double, Lvalue and Rvalue **Type Conversion:** Type Promotion in expression, Conversion by Assignment, Truncation and Casting Arithmetic expression. **Decision and Case Control Structure:** if, if-else, nested if-else, Decisions using switch, switch versus if-else ladder, goto. **Loop Control Structure:** For loop, while loop, do-while loop, nesting of loops, break, and continue. **Arrays:** Introduction, one-dimensional and two-dimensional Array-Declaration, Initialization, Address Calculation. **Operations on Arrays:** Insertion, Deletion, Linear Search & Bubble Sort. **String:** Introduction, One dimensional and two dimensional Array-Declarations, Initialization **Operations on String:** Length, Copy, Reverse, Concatenate, Compare with & without built-in functions.	25
II	**Functions:** Declaration and Definition, Category of Functions, Parameter Passing Techniques – Call by Value, Passing Arrays to Functions. **Introduction to Storage Classes:** Auto, Static, Extern and Register. **Recursion:** Mechanics of Recursive Call, Implementation of Recursion, Recursion vs. Iteration. **The C Preprocessor:** Introduction, Macro Expansion and File Inclusion, Conditional Compilation and Miscellaneous Directives. **Pointers:** Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Arrays and Pointers, Pointer and Strings, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointer to an Array, Two Dimensional Array and Pointers, Pointers to Functions, Dynamic Memory Allocation, void Pointer and Null Pointer. **User Defined Types:** enum, typedef, Union and Structure - Declaration, Initialization, Nested Structures, Arrays of Structures, Structure and Pointer, Passing Structure Through Function. Difference between Structures and Union. **File Handling:** Data and Information, File Concepts, File Organization, File Operations: Open, Read, and Close, Trouble in Opening a File. File Opening Modes, Working with Text Files. Random Access to Files of Records. Introduction to Command Line Arguments.	25

Text Books:

- Behrouz A. Forouzan and Richard F. Gilberg, "Computer Science – A Structured Programming Approach Using C", C Language Learning, 2007

Reference Books:

- Herbert Schildt, “C: The Complete Reference”, 5th Edition, McGraw Hill Education
- K. N. King, “C Programming a Modern Approach”, W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, “The C Programming Language”, PHI, 2nd Edition, 2011.
- P. Dey and M. Ghosh, “Programming in C”, Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO2,CO3,CO7.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of problem solving skills.
- CO2: Apply the basic principles of programming in C language.
- CO3: Understand the concepts of arrays and strings in C language.
- CO4: Apply the concepts of functions to solve real world problems.
- CO5: Illustrate the concepts of recursion.
- CO6: Understand the concepts of pointers in C language.
- CO7: Understand the basic concepts of file handling.
- CO8: Develop algorithmic solutions to simple computational problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO10/PSO1,PSO3
CO3	PO1,PO2,PO3,PO4/PSO1,PSO3
CO4	PO1,PO3, PO12/PSO1,PSO2
CO5	PO1,PO2,PO4 /PSO1,PSO3
CO6	PO1,PO2,PO3,PO4/PSO1,PSO2
CO7	PO1,PO3,PO6 /PSO1
CO8	PO1,PO2,PO4,PO10,PO12/PSO1,PSO3

BCSC0002: OBJECT ORIENTED PROGRAMMING

OBJECTIVE: *This course introduces the Object-Oriented programming paradigm to students. It also teaches a student how to think objectively and model a Java program for solving real-world problems.*

CREDITS: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Object-Oriented Programming:** Features of Object-Oriented Programming, Introduction to Object-Oriented Java Programming. **g Java Technology & Environment:** Understanding the compilation process of the JVM, JVM vs JDK vs JRE, Key Features of Java, Structure of a simple Java program. **Working with Java Primitive Data Types:** Strongly Typed nature of Java, Primitive Data Types in Java, The new 'var' keyword, Scope of a variable. **Accepting User Input in Java Programs:** using the Scanner class, using command line arguments. **Programming Constructs:** Sequence, Selection, Iteration & Transfer Statements, For-Each Loop. **Working with Java Arrays**: Declaring and Initializing One-Dimensional and Two-Dimensional Arrays in Java, Introduction to java. util. Arrays class. **The String API:** String Data Type, commonly used methods from the String API, StringTokenizer, StringBuilder & StringBuffer. **Creating and Using Methods:** Signature of a method, Types of Methods, Overloading methods in a class, Static and Non-Static Methods. **Describing and Using Objects & Classes:** Declare the structure of a Java class, declaring members of a class (fields and methods), declaring and using Java Objects, lifecycle of an Object (creation, assignment, dereferencing and garbage collection), Constructors of a class, Overloading Constructors, Constructor chaining using 'this' and 'super' keyword. **Using Java Packages:** create and import Java packages and static imports, abstracting program logic to packages, creating executable main class, running the executable class inside a package. **Applying Encapsulation**: Using access modifiers with/in a class, principles of encapsulation. **Programming Abstractly Through Interfaces:** create and implement Interfaces for programs, private and default methods in Interfaces, declaring Abstract Classes, Constructors in Abstract Classes. Marker Interface, Functional Interfaces, Lambda Expressions in Java.	20

II	**Reusing Implementations using Inheritance:** Declaring Subclasses and Superclasses, extend Abstract Classes, implementing Interfaces, exploring polymorphic behaviour by overriding methods, Object Types vs Reference Types, differentiate overloading, overriding and hiding. **Exception Handling:** Exception Hierarchy, Need of Exception Handling, Checked Exceptions, Unchecked Exceptions and Errors, Try-Catch Blocks, Finally, Throw & Throws Keywords, creating and handling Custom Exceptions. **Threads in Java:** Life Cycle of a Thread, creating threads using Runnable and Thread, 'sleep ()', Thread Priorities. **Using Wrapper Classes:** Wrapper Classes in Java, Boxing-Unboxing-Auto Boxing-Auto Unboxing. **Generics & Collections:** Creating Generic classes, Generic Methods, Diamond Notation, Wildcards, Type Erasure, Collection Hierarchy, Base Interfaces, Lists, Sets and Maps. **The Stream API:** Introduction to the Stream API, using lambda expressions in Streams. **Regular Expressions:** Pattern and Matcher Class. **JDBC:** JDBC Drivers, Connecting to a MySQL Database, Driver Manager, Connection Interface, Statement Interface, Result Set Interface, Prepared Statements.	18

Text Book:

- Herbert Schildt , "The Complete Reference, Java Eleventh Edition", Oracle Press, 2019.

Reference Book:

- Cay S Hosrtmann , "Core Java Volume I—Fundamentals, Eleventh Edition", Pearson, 2018
- Rogers Cadenhead , "Sams Teach Yourself Java in 21 Days (Covers Java 11/12), 8th Edition", Pearson, 2020.

Focus: This Course focuses on Employability under CO3, CO5, CO7, CO8.

Outcomes: After completion of the course, students will be able to -

- CO1: Understand the basics of Object-Oriented Programming paradigm.
- CO2: Construct the logical flow of programs by using the sequence, selection, iterations and transfer statements.
- CO3: Apply the concepts of Object- Oriented Programming to model programs in Classes, Abstract Classes, Interfaces and Enums, and simplify program function by dissecting it into methods.
- CO4: Understand accessibility of members in a program unit and create packages to prevent namespace collisions.
- CO5: Predict run-time errors in a program by examining program functioning.
- CO6: Show the parallel processing capabilities of a program using a multithreading concept.
- CO7: Experiment with the predefined classes and interfaces defined in the Collections Framework.
- CO8: Develop a program using JDBC connectivity to demonstrate data persistence.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1 /PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/ PSO2
CO7	PO1,PO2,PO11/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO2

BCSC0003: DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database & NoSQL system. Students learn how to design and create a good database.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System , Database System Vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with Case Studies. Data Modeling Using the Entity-Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. Relational Data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization I:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, Non-Redundant Cover, Canonical Cover	20
II	**Database Design & Normalization II:** 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, MVD and JDs, Inclusion Dependence. **File Organization:** Indexing, Structure of Index files and Types, Dense and Sparse Indexing **Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication.	20

Text Books:

- Elmasri and Navathe , "Fundamentals of Database Systems", 6th Edition, Addison Wesley., 2010.
- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. & Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focus on Employability and Skill Development under CO1,CO2,CO6.

Outcome: After the completion of the course, the student will:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.

- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss indexing mechanisms for efficient retrieval of information from a database.
- CO8: Discuss recovery system and be familiar with introduction to web database, distributed databases.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1 /PSO1
CO2	PO2, PO3/ PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3,PO9/ PSO2
CO7	PO1,PO11 /PSO1
CO8	PO1,PO3,PO12/ PSO2

BCSC0004: OPERATING SYSTEMS

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Operating System and its Classification - Batch, Interactive, Multiprogramming, Time sharing, Real Time System, Multiprocessor Systems, Multithreaded Systems, System Protection, System Calls, Reentrant Kernels, Operating System Structure- Layered structure, Monolithic and Microkernel Systems, Operating System Components, Operating System Functions and Services. **Processes:** Process Concept, Process States, Process State Transition Diagram, Process Control Block (PCB), Process Scheduling Concepts, Threads and their management. **CPU Scheduling:** Scheduling Concepts, Performance Criteria, Scheduling Algorithms, Multiprocessor Scheduling. **Process Synchronization:** Principle of Concurrency, Implementation of concurrency through fork/join and parbegin/parend, Inter Process Communication models and Schemes, Producer / Consumer Problem, Critical Section Problem, Dekker's solution, Peterson's solution, Semaphores, Synchronization Hardware. **Classical Problem in Concurrency:** Dining Philosopher Problem, Readers Writers Problem.	20
II	**Deadlock:** System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock, Combined Approach. **Memory Management:** Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation. **Virtual memory concepts:** Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Locality of reference. **I/O Management and Disk Scheduling:** I/O devices, I/O subsystems, I/O buffering, Disk storage and disk scheduling. **File System:** File concept, File organization and access mechanism, File directories, File allocation methods, Free space management.	20

Text Books:

- Silberschatz, Galvin and Gagne , "Operating Systems Concepts",9th Edition, Wiley, 2012.

Reference Books:

- Sibsankar Halder and Alex a Aravind ," Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability and Skill Development under CO1,CO2,CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the classification of operating system environment.
- CO2: Understand the basic of process management.
- CO3: Apply the concept of CPU process scheduling for the given scenarios.
- CO4: Illustrate the process synchronization and concurrency process in operating system.
- CO5: Analyze the occurrence of deadlock in operating system.
- CO6: Describe and analyze the memory management and its allocation policies.

- CO7: Understand the concepts of disk scheduling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO4/PSO1,POS3
CO4	PO3,PO4,PO6/PSO3,PSO4
CO5	PO1,PO4/PSO1,PSO3
CO6	PO1,PO2 /PSO1,PSO3
CO7	PO1,PO2,PO7/PSO1,PSO3

BCSC0005: COMPUTER ORGANIZATION

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**PREAMBLE:** Subject Introduction, Basic organization of the computer and block level description of the functional units, Number Representation, Fixed and floating-point Number Representation-Arithmetic Addition/subtraction, overflow, IEEE standard for floating point representation, **Basic Organization:** Introduction to combinational circuit - Half Adder, Full Adder, carry look ahead adder, Multiplexor/ De multiplexer and Decoder/Encoder, Introduction to sequential circuit- Flip-Flops, Synchronous and Asynchronous Counters, Register, Bus and memory Transfer Language. **Arithmetic Operations:** Addition and subtraction of signed numbers, Hardware implementation of Method, Multiplication: Signed operand multiplication, Booths algorithm, Hardware implementation of Algorithms, Array Multiplier. **Processor Organization:** General register organization, Single Accumulator and Stack organization, Addressing Modes, Types of Computer Instructions – one, two, three & four address, Instruction Cycle, Instruction Formats.	20
II	**Micro-operations:** Arithmetic, Logical & Shift Micro operations with some applications. **Multiprogramming and Multiprocessing:** Introduction to pipelined operation. **Hardwired & Microprogrammed Unit:** Execution of a complete instruction & Branch Instructions, Hardwired control Unit, Micro programmed control Unit, Micro-Instructions, Microinstruction with Next Address field, Pre-Fetching Microinstructions, Concept of Horizontal and Vertical Microprogramming. **Memory:** Basic concept and Hierarchy, RAM memories, 2D, 2 & 1/2D Memory Organization, ROM Memories, Cache Memories: Concept and Design issues performance, Address mapping and Replacement, Auxiliary memories: Magnetic disk, Magnetic tape and Optical disks, Virtual memory: Concept and Implementation. Input/Output: Peripheral Devices, I/O interface, I/O ports. **Interrupts:** Interrupt hardware, Types of Interrupts and Exceptions, Buses, Bus architecture, Types of Buses and Bus Arbitration. Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O, Direct Memory Access, I/O channels and Processors, Standard communication interfaces.	**20**

Text Books:

- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4th**Edition**, Elsevier Publication, 2008.
- William Stalling , "Computer Organization",8th Edition, PHI, 2011.
- V. CarlHamacher, Zaky , "Computer Organization",4th International Edition, TMH, 1996.

- John P Hays, "Computer Organization", 2nd Edition, TMH.
- Tannenbaum , "Structured Computer Organization", 5thEdition, PHI, 2005.
- P Pal Chaudhry , "Computer Organization & Design", 2ndEdition, PHI, 2002.

Focus: This Course focuses on Employability under CO1, CO2, CO6

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the basics of digital computer system.
- CO2: Demonstrate the principle of arithmetic operations on unsigned, signed integers and floating point numbers.
- CO3: Understand the concepts of Combinational and Sequential circuits and their applications.
- CO4: Understand the CPU architecture and organization.
- CO5: Explain the basic concepts of pipelining.
- CO6: Design the steps for the execution of the complete instruction for hardwired and micro-programmed control unit.
- CO7: Explain the function of memory hierarchy.
- CO8: Determine the interface of CPU with input/output devices and their modes of transfer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO1,PO3/PSO1
CO3	PO2,PO3,PO5/PSO2
CO4	PO2,PO3,PO4/PSO1,PSO3
CO5	PO2,PO3,PO4/PSO2
CO6	PO1,PO2,PO3/PSO1,PSO3
CO7	PO2,PO3,PO5/PSO2,PSO3
CO8	PO3,PO4/PSO1

BCSC0006: DATA STRUCTURES AND ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs*.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Terminology, Elementary Data Organization, Properties of an Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic Notations – Big-Oh; Operations on Data Structure, Abstract Data Types (ADT). **Linked Lists:** Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Generalized Linked List, Polynomial Representation and Addition. **Stacks:** Primitive Stack Operations - Push & Pop, Array and Linked Implementation of Stack in C, Application of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of Infix to Postfix expression, Recursion, Principles of Recursion, Tail Recursion, Removal of Recursion, use of stack in Recursion, Tower of Hanoi Problem. **Queues:** Operations on Queue - Add, Delete operations, Implementation of Queue Using Array and Linked List, Circular Queues, Deque and Priority Queue. **Trees:** Basic Terminology, Array Representation and Dynamic Representation; Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Tree Traversal Algorithms - Inorder, Preorder and Postorder , Threaded Binary Trees, Traversing Threaded Binary Trees.	20
II	**Search Trees:** Binary Search Trees (BST), Insertion and Deletion in BST, AVL Trees, Introduction to M-Way Search Trees, B Trees. **Searching:** Sequential Search, Binary Search. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Two Way Merge Sort, and Heap Sort. **Graphs:** Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees – Prim's and Kruskal's Algorithm; Shortest Path Algorithm – Bellman-Ford and Dijkstra's Algorithm. **Hashing & Indexing:** Hash Function, Collision Resolution Strategies. Primary Indices, Secondary Indices, Indexing and Hashing Comparisons.	20

Text Book:

- Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein , "Data Structures Using C and C++", 2nd Edition, PHI, 2009.

Reference Books:

- Horowitz and Sahani , "Fundamentals of Data Structures", 3rd Edition, W H Freeman & Co, 2004-05.
- Jean Paul Trembley and Paul G. Sorenson , "An Introduction to Data Structures with Applications", 2nd Edition, TMH, 2007.
- R. Kruse, "Data Structures and Program Design in C" , 2nd Edition, Pearson Education, 2004.
- Lipschutz Schaum's Outline Series , "Data Structures", 12th Reprint, TMH, 2010.
- G A V Pai , "Data Structures and Algorithms", TMH, 2009.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.
Outcome: After completion of course, student will be able to:

- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2
CO3	PO1/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4/PSO3
CO6	PO2/PSO4
CO7	PO2/PSO4

BCSC0007: INTRODUCTION TO MICROPROCESSORS

Objective: *Objective of this subject is to introduce the basic concepts of microprocessor and assembly language programming. Identify and explain the operation of the components of typical microprocessor: the role of the ALU, registers, stack and the use of interrupts.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Microprocessors Evolution and Types, Basics of Pentium Microprocessor, Microprocessor Application, **8-Bit Microprocessor:**8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction Set - Data Transfer Operation, Arithmetic Operation, Logic Operations and Branch Operations; Introduction to Assembly Language Program. **Programming Technique with Additional Instruction**: Looping, Counting, Indexing, Additional Data Transfer and 16-Bit Arithmetic Instruction, Counters and Time Delays, Stack and Subroutine.	20
II	**16 Bit Microprocessor:** Architecture of 8086 – Register Organization, Execution Unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities. **Peripheral Interfacing:** I/O Programming, Programmed I/O, Interrupt Driven I/O, DMA I/O, Memory-Mapped I/Os. **Peripheral Devices:** 8237 DMA Controller, 8255 Programmable Peripheral Interface, 8253/8254 Programmable Timer/Counter, 8259 Programmable Interrupt Controller.	18

Text Books:

- N Senthil Kumar, M Saravanan, and S Jeevananthan , "Microprocessors and Microcontrollers", Oxford University Press India, 2010.

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- Ray A.K. Bhurchandi.K.M , "Advanced Microprocessor and Peripherals", TMH, 2002.
- D. V. Hall, "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.
- Y.C. Liu and G.A. Gibson ,"Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design", 2nd Edition, PHI, 2003.

Focus: This Course focuses on Employability under CO1, CO2, CO6

Outcome: After the completion of the course, the student will be able to:

- CO1: Demonstrate the Microprocessor internal architecture and its operations.
- CO2: Develop programs based on 8085 microprocessor instruction set and addressing mode.
- CO3: Develop program using looping, counting, indexing, counter and time delays.
- CO4: Understand the concept of stack and subroutine for modular approach.
- CO5: Compare accepted standards and guidelines to select microprocessor (8085 & 8086) to meet performance requirements.
- CO6: Analyze the concept of interfacing the processor to external device with I/O programming & Interrupt Driven I/O.
- CO7: Understand the working of interfacing chips (8237, 8253/54, 8255 & 8259).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1,PSO2
CO3	PO2,PO3/PSO1,PSO2
CO4	PO1,PO2,PO3/PSO1,PSO3
CO5	PO2,PO3,PO5/PSO1,PSO3
CO6	PO1,PO2/PSO3
CO7	PO1,PO2,PO4/PSO3

BCSC 0008: Computer Networks

Objective: *The objective is to understand fundamental underlying principles of computer networking, details and functionality of layered network architecture.*

Credits: 03 **Semester - IV** **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Introduction Concepts**: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design, Physical Layer Transmission Media, Line coding scheme, switching methods (circuit switching, Packet switching), TDM. **Medium Access sub layer**: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols, CSMA, CSMA/CD, Overview of IEEE standards. **Data Link Layer**: Error detection and correction, Flow control (sliding window protocol)	20
II	**Network Layer**: Network Layer –IP addressing, subnet, CIDR, VLSM, Internetworking, Address mapping, routing. Connecting devices. **Transport Layer**: Transport Layer - Design issues, connection management, Flow control, TCP window management, congestion control-slow start algorithm. **Application Layer**: Data compression, Data Encryption, File Transfer, DNS, HTTP, SMTP, TELNET **Introduction to IPv6, transition from IPv4 to IPv6.**	20

Text Books:

- Forouzan B. A. ,"Data Communication and Networking", 4th Edition, McGrawHill, 2004.

References:

- Kurose, J.F. and Ross K.W. ,"Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Addison-Wesley, 2005.
- A.S. Tanenbaum ,"Computer Networks", 2nd Edition, Prentice Hall India, 2006.

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO5,CO8.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the concept of OSI and TCP/IP reference model.
- CO2: Understand the basics of data transmission at physical layer.
- CO3: Understand the channel allocation using ALOHA, CSMA and CSMA/CD.
- CO4: Apply error detection and correction technique to eliminate transmission error.
- CO5: Analyze the fixed and variable length address (IPv4) subneting for the given scenarios.
- CO6: Understand the design issues of the transport layer.
- CO7: Understand the mechanism of protocols at application layer such as FTP, HTTP, Telnet, DNS.
- CO8: Understand IPv6 addressing and differentiate it from IPv4.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO12/PSO1
CO2	PO1/PSO2
CO3	PO1,PO4/PSO1,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO4,PO6/PSO3
CO6	PO2,PO4/PSO1
CO7	PO5,PO12/PSO2
CO8	PO4,PO7/PSO4

BCSC0009: SOFTWARE ENGINEERING

Objective: *Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility.*

L–T–P-J: 3–0–0-0

Credits: 03

Module No.	Content	Teaching Hours
I	**Introductory Concepts**: The evolving role of software – characteristics, components and applications. **Process Models:** Waterfall Model, Prototyping, Incremental, Spiral. **Agile software Development**: Introduction to Agile, Agile software development framework. **Software Requirement Specification**: Requirement Process, SRS Components, Requirement Specifications with Use Cases Diagram. **Software Project Planning:** Project Planning Objectives. **Software Metrics:** Size, Function Point, Staffing, Project Estimation Methods– COCOMO Model. **Function-Oriented Design**: Problem Partitioning, Abstraction, Top Down and Bottom Up Design. **Module-Level Concepts:** Coupling, Cohesion, Design Notation and Specification - Structure Charts; Structured Design Methodology - Data Flow Diagram, Sequence Diagram.	20
II	**OO Analysis and OO Design:** OO Concepts, Introduction to UML Design Patterns: Class Diagram, Activity Diagram, State Chart Diagram. **Coding**: Coding Process, Verification – Code Inspections, Software Metrics. **Testing Fundamentals**: Test Case Design, Black Box Testing Strategies, White Box Testing, Unit Testing, Integration Testing, System Testing. **Introduction to Automation Testing and Testing Tools:** Automated Testing Process, Framework for Automation Testing, Introduction to Automation Testing Tool. **Software Quality:** Models, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model. **Software Maintenance**: Models Cost of Maintenance, Re-engineering, Reverse Engineering.	18

Text Books:

- R. S. Pressman , "Software Engineering: A Practitioners Approach", 7thEdition, McGraw Hill, 2010.

Reference Books:

- K. K. Aggarwal and Yogesh Singh , "Software Engineering", 3rd Edition, New Age International Publishers, 2008.
- Rajib Mall , "Fundamentals of Software Engineering", 3rd Edition, PHI Publication, 2009.
- R.E Fairley , "Software Engineering", McGraw Hill, 2004.
- Sommerville , "Software Engineering", 9th Edition, Pearson Education, 2010.

Focus: This Course focuses on Employability and Skill Development/Entrepreneurship under CO1,CO2,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of software engineering.
- CO2: Apply software processes to solve real world problems.
- CO3: Estimate the cost, effort and schedule of software using COCOMO Model.
- CO4: Analyze the software design techniques (structure chart, SDM, sequence diagram).

- CO5: Understand the basic concepts of OO analysis and design.
- CO6: Develop the test cases to validate the software.
- CO7: Understand the basic models of software Quality and maintenance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7/PSO1
CO2	PO2,PO3/PSO4
CO3	PO2,PO11/PSO3
CO4	PO3,PO10/PSO4
CO5	PO3,PO7/PSO1
CO6	PO5,PO12/PSO2
CO7	PO4,PO9,PO12/PSO1

BCSC0010: DISCRETE MATHEMATICS

Objective: *The objective is to introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in computer science.*

Credits: 4 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Sets, Relations and Functions:** Introduction to Set Theory, Venn diagrams, algebra of Sets, Inclusion-Exclusion Principle, Partitions, Proof Techniques, Relations, Properties and their types, Function and their types. Recurrence Relations and Generating Functions **Introduction to Counting Principle**: Permutation, Combination, Permutation with Repetition, Combination with Repetition, Pigeonhole Principle. **Probability Theory**: Introduction to Probability Theory, Conditional Probability, Total Probability, Bayes Theorem.	20
II	**Propositional Logic -** Logical Connectives, Truth Tables, Normal Forms (Conjunctive and Disjunctive), Validity; **Predicate Logic -** Quantifiers, Inference Theory, Methods of Proof: Direct, Indirect, Mathematical Induction. **Algebra**: Motivation of Algebraic Structures, Finite Groups, Subgroups and Group Homomorphism; Lagrange's Theorem; Commutative Rings and Elementary Properties; **Graph Theory:** Introduction to Graphs, Types: Planner, Directed, Complete, Bipartite Graph, Isomorphism , Euler Graph, Hamiltonian Graph, Operations on Graphs, Representation of graphs, Connectivity.	20

Text Book:

- Kenneth H Rosen , "Discrete Mathematics and Its Applications", 7th edition, TMH, 2012.

Reference Books:

- J.P. Tremblay , "Discrete Mathematical Structures with Applications to Computer Science", TMH, New Delhi, 1997.
- V. Krishnamurthy , "Combinatorics : Theory and Applications", East-West Press, New Delhi, 1986.
- Ralph P. Grimaldi , "Discrete and Combinatorial Mathematics- An Applied Introduction", 5th Edition, Pearson Education, 2004.
- C.L. Liu , "Elements of Discrete Mathematics", 2nd Edition, TMH, 2000.

Focus: This Course focuses on Employability and Skill Development under CO1,CO2,CO3,CO7,CO8

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the notion of mathematical thinking and proofs to solve the problem.
- CO2: Apply the basics of discrete probability and number theory to solve the real world problem.
  CO3: Analyze basic discrete structures and algorithms using effectively algebraic techniques.
- CO4: Analyze mathematical concepts like sets, reasoning, relational algebra and graph theory to solve optimization problems.
- CO5. Analyze the validity of an argument using logical notation.
- CO6. Demonstrate the basic structures of proof techniques to write and evaluate the validity of arguments.
- CO7. Understand the basic principles of sets, set equalities and operations in sets.
- CO8. Apply counting principles to determine probabilities.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO3
CO2	PO1,PO3/PSO4
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3
CO5	PO1,PO2/ PSO3
CO6	PO1,PO3/PSO2,PSO3
CO7	PO1,PO2/PSO1
CO8	PO1,PO3/PSO1,PSO4

BCSC0011: THEORY OF AUTOMATA & FORMAL LANGUAGES

Objective: *The objective of this course is that students will study and compare different models and views of the abstract notion of computation and its various aspects.*

Credits:04 **Semester V** **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem; FA with Output - Moore and Mealy machine, Applications and Limitations of FA. **Regular expression (RE):** Regular Expression to FA, DFA to Regular Expression, Arden Theorem, Non Regular Languages, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages. **Push Down Automata (PDA):** Introduction, Language of PDA, Acceptance by Final State, Acceptance by Empty Stack, Deterministic PDA.	20
II	**Context Free Grammar (CFG) and Context Free Languages (CFL):** Introduction, Derivation Trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Simplification of CFGs, Normal Forms for CFGs - CNF and GNF; Pumping lemma for CFLs, Equivalence of PDA and CFG. **Turing machines (TM):** Basic Model, Definition and Representation, Variants of Turing Machine and their equivalence, TM for Computing Integer Functions, Universal TM, Church's Thesis, Recursive and Recursively Enumerable Languages, Halting Problem, Introduction to Computational Complexity.	20

Text Books:

- K.L.P. Mishra and N. Chandrasekaran ,"Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI, 2006.

Reference Books:

- Hopcroft, Ullman ,"Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2013.
- Martin J. C," Introduction to Languages and Theory of Computations", 4th Edition, TMH, 2011.

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of Context Free languages, Expression and Grammars.
- CO2: Analyze the conversion of NFA to DFA, Mealy to Moore and Moore to Mealy.
- CO3: Analyze the process to convert regular expression to DFA, DFA to regular expression, and minimization of DFA.
- CO4: Develop the PDA for the context free language and context free grammar.
- CO5: Analyze that the grammar is ambiguous or unambiguous.
- CO6: Apply the process to convert CFG to CNF and GNF.
- CO7: Understand the concept of Turing machine and its variants.
- CO8: Design the Turing machine for the real world application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO4
CO2	PO2,PO3/PSO3
CO3	PO2,PO3,PO9,PO12/PSO1,PSO3,PSO4
CO4	PO1,PO3,PO5,PO9/PSO3,PSO4
CO5	PO1,PO2,PO4/PSO3
CO6	PO2,PO3/PSO3
CO7	PO1,PO2/PSO1,PSO3
CO8	PO3,PO12/PSO1,PSO2,PSO3

BCSC0012: DESIGN & ANALYSIS OF ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and concepts including Trees, Recursion & Dynamic programing.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Algorithms, analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Sorting and order Statistics - Shell sort, Quick sort, Merge sort, Heap sort, Comparison of sorting algorithms, Sorting in linear time. **Advanced Data Structures:** Red-Black trees, B – trees, Binomial Heaps, Fibonacci Heaps. Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching.	20
II	Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets Dynamic programming with examples such as Knapsack. All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem	20

Text Books:

- Thomas H. Coremen, Charles E. Leiserson and Ronald L. Rivest , "Introduction to Algorithms", Third edition, Prentice Hall of India, 2008.

Reference Books:

- Gilles Brassard Paul Bratley ," Fundamentals of Algorithms", Prentice Hall, 1996.
- Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran , "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd, 2008.
- Levitin , "An Introduction to Design and Analysis of Algorithms", Pearson., 2008.

Focus: This Course focuses on Employability under CO1,CO2,CO6.

Outcome: After completion of course, student will be able to:

- CO1: Understanding of complexity representation in terms of Big Oh, Theta and Omega notations.
- CO2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms (quick sort and merge sort).
- CO3: Compare and analyze different data structures (RB Tree, B Tree, Binomial Heaps, Fibonacci Heaps).
- CO4: Understand the major graph algorithms (DFS, BFS, Dijkstra's Bellman Ford) and their analyses.
- CO5: Understand the greedy paradigm and able to analyze when an algorithmic design situation calls for it. Synthesize greedy algorithms (Optimal Reliability Allocation, Minimum Spanning Trees, factorial Knapsack) and analyze them.
- CO6: Synthesize dynamic-programming algorithms (0/1 knapsack problem, Resource allocation problem, Warshal's and Floyd's algorithms) and analyze them.
- CO7: Understand the backtracking paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize backtracking algorithms (N Queen Problem, TSP Problem, sum of subsets problem, Graph Coloring) and analyze them.

- CO8: Understand the branch and bound paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize branch and bound algorithms (N Queen Problem, TSP Problem, Hamiltonian Cycles, Graph Coloring) and analyze them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4,PO12/PSO1,PSO3
CO2	PO1, PO3,PO4,PO5/PSO1,PSO3
CO3	PO1,PO3, PO6/PSO1,PSO3
CO4	PO1,PO2,PO3, /PSO1,PSO3
CO5	PO1,PO2 /PSO1,PSO3
CO6	PO1,PO2,PO3, PO6/PSO1,PSO3
CO7	PO1,,PO4,PO12/PSO1,PSO3
CO8	PO1,PO2,PO3,PO4,PO12/PSO1,PSO2

BCSC0014: APPLIED DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database& NoSQL system. Students learn how to design and create a good database.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with case studies. **Data Modeling Using the Entity-Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. **Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, Non Redundant Cover, Canonical Cover, MVD and JDs, Inclusion Dependence.	26
II	**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication. **NoSQL System:** RDBMS vs NoSQL, BASE properties, Key-value, Columnar, Document and Graph-Based database, Introduction of MongoDB, Cassandra, Neo4j and Riak. **Database Programming using Python**: Database connectivity, Retrieving Data from Database, Parameters Passing, Executemany Methods, Cursor Attributes, Invoke Stored Procedures, Invoke Stored Functions.	26

Text Books:

- Elmasri and Navathe , “Fundamentals of Database Systems”, 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler , “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.

References Books:

- Date C J,” An Introduction to Database Systems”, 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , “Database Concepts”, 5th Edition, TMH, 1998.
- Redmond, E. &Wilson, “Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement”, 1st Edition.

Focus: This Course focuses on Employability under CO1, CO2,CO6.

Outcome: After completion of course, student will be able to:

- CO1: Understand the concept of database management systems and Relational database.

- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss recovery system and be familiar with introduction to web database, distributed databases.
- CO8: Explain the differences between RDBMS and No-SQL,BASE properties and No-SQL databases.
- CO9: Design and implement the database system with the fundamental concepts of DBMS using Python.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO1
CO2	PO2,PO3/PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3/PSO2
CO7	PO1,PO3/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO4
CO9	PO1,PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0808: APPLIED DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL and NoSQL databases.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Introduction to MongoDB and its Installation on Windows or Linux, Description of mongo Shell, create database and show database, Commands for MongoDB and To study operations in MongoDB – Insert, Query, Update, Delete and Projection • To implement Database connectivity using Python	24

References Books:

- Date C J,” An Introduction to Database Systems”, 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , “Database Concepts”, 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, “Database Management System”, TMH
- Sadalage, P. & Fowler , “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Implement the procedural language (PL/SQL) and Triggers.
- CO3: Apply NoSQL queries in MongoDB.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO2,PO3,PO5/PSO2,PSO3
CO3	PO5/PSO2

BCSC 0600: INTRODUCTION TO OPEN SOURCE SOFTWARE AND OPEN STANDARDS

Objective: *The concept of Open Source Software and to learn the Open Source Adoption History and Evolution, Various types of Open Source Software its strength and Concept of standards and licenses and its types.*

Credits: 02 **Semester - I** **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Open Source:** Introduction to Open Source Software - History of Open Source Software, Initiation of Open Source project start; Open Source Software examples: The Origins, The GNU projects, The Operating System GNU/Linux, The Graphical User Interface KDE/GNOME, Apache Web Server, **Application Software**; Strengths and Advantages of Open Source Software - Network effects, Lower cost, Availability, Maintainability. Drivers for Adoption - Lower cost of ownership, Quality, Innovation reuse, Technical competence; Open Source Software Assessment, Examples of Open Source Adoption in the World, Open Source Challenges. Standards, Licenses, Contribution to open source community-Evolution of UNIX, GNU General Public License - Genesis of GNU Myth Buster, Brook's law; Open Source Community; Apache Web Server; Apache Software Foundation (ASF); How to contribute to open source projects.	13
II	**Introduction to standards**, Types of standard, Lifecycle of standard, Importance and benefits of standards. **Adoption of Open Source**: Introduction; Drivers for Open Source adoption; Adoption Methods and Process; examples of Open Standard Adoptions in the World; Open Source Challenges **.Case Study On Open Standard and Software:** Introduction. Case Study 1 - Open Standard Case Study 2 - Linux - The Operating System – an Overview, Linux Basics, Various Linux distributions available, Preparing for Installation – Installation Checklist, Hardware Requirements, Partitioning, Installation problems ,Working with the System, Shells and Utilities, Linux commands, File Handling using vi editor, Getting familiar with shell scripts	13

Text Books:

- Introduction to Open Source Software & Open Standards (IBM ICE Publication)

Reference Books:

- Handbook of Research on Open Source Software: Technological, Economic, and Social Perspectives by Kirk St. Amant and Brian Still - IGI Global © 2007.
- Open Source: Technology and Policy by Fadi P. Deek and James A. M. McHugh - Cambridge University Press © 2008.
- Perspectives on Free and Open Source Software by Joseph Feller, Brian Fitzgerald, Scott A. Hissam and Karim R. Lakhani (eds) The MIT Press © 2005.
- Understanding Open Source and Free Software Licensing First Edition , Annotated by Andrew M. St. Laurent

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: After completion of course, the student will be able to:

- CO1: Explain Open Source Software and the History of Open Source Software.
- CO2: Explain Application Software and Open Source Software Assessment.
- CO3: Understand the basics of open Standards.
- CO4: Understand the reason associated with open source Adoption.
- CO5: Implement the shell commands and shell scripts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO1/PSO1
CO4	PO1/PSO1
CO5	PO1,PO2/PSO1

BCSC 0601 WEB PROGRAMMING THROUGH PHP & HTML

Objective: *This course introduces the building of dynamic web solutions using PHP programming and OO concepts and its connectivity with database.*

Credits: 03 **Semester II** **L–T–P-J: 3–0–0-0**

Module No.	Content	Hours
I	**Introduction to Client Server Architecture**: Components of Client-Server Application, Client-Server Models and their Benefits, Characteristics of Web Projects, Static V/s Dynamic Websites and Web Portal. **Web Servers:** Introduction to prominent Web Servers, Installation of WAMP/XAMPP and Eclipse IDE **Client Side Implementation**: Introduction to HTML, Formatting tags, Meta, Anchor, List, Table, Headers, Frames and iframes, Image, Form, Fieldset, Legend, and other tags, their usage and implementation, Introduction of Formatting using CSS, Basics of Javascript, Statements, Functions in Javascript, Integrating Javascript with Various Elements of HTML, Validating a form using Javascript. **DOM:** Introduction, Methods and Properties and their usage. **PHP Basics**: Introduction to PHP, Basic Syntax of PHP, Embedding PHP in HTML, Comments, Variables, Constants, Managing Variables, Operators and Operator Precedence and String Manipulation functions. **Conditional Control Structures:** If statement, If- else statement, If- else if statement, Nested If, Switch statement. **Looping Control Structures:** For loop, While loop, Do- While loop, For-each, Break and Continue. **Functions in PHP**: Functions, User-Defined function, Call by value and call by references, Understanding variable scope, Global Variables, Static Variables, Include and Require, Built-in functions in PHP.	20
II	**Arrays**: Arrays and its types in PHP, Accessing Elements of an Array, Modifying Elements of an Array, Functions in array, Array Sorting, Multidimensional Array. **PHP File Handling:** Introduction, File Open, File Creation, Writing to files, Reading from File, Searching a record from a file, Closing a File. **Class and Object:** Introduction, Object, Class, Defining Class in PHP, Object in PHP, Usage of this variable, Constructor, Constructor with Parameters. **Exception Handling**: Introduction to Exception, Exception Handling mechanisms, Creating Custom Exceptions, Multiple Catch Blocks, Exception Propagation, Error Handling in PHP. **Form Handling and Session Management in PHP**: Accessing and displaying Form data from different Form components, Differences among $_GET, $_POST and $_REQUEST variables, Session management, Session operations, Session tracking mechanism, Clearing/Modifying data from session, Destroying a session, Setting and Retrieving Cookies, Uploading a file, displaying its details, restricting various details of a file during upload, checking for errors and reading Error code table. **Database Management**: Introduction to DBMS, SQL Basics, Database connectivity in PHP with MySQL, Executing Queries from frontend, **XML:** Introduction to XML, Parsing XML document using DOM parser, Various operations on XML document using PHP.	20

Reference Books:

- IBM Student Guide on “Web Programming through PHP & HTML”

- Robin Nixon: "Learning PHP, MySQL and JavaScript" "O'Reilly Media, Inc.", July 2009.
- Dave W Mercer, Allan Kent, Steven D Nowicki, David Mercer, Dan Squier, Wankyu Choi – Beginning PHP, Wiley Publishing, Inc
- Ivan Bayross - "HTML, DHTML, JavaScript, Pearl & CGI", Fourth Revised Edition, BPB Publication
- "Programming PHP", RasmusLerdorf and Kevin Tatore, Shroff Publishers & Distributors Pvt.Ltd

Focus: This Course focuses on Employability under CO1,CO2,CO5,CO6.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of client server architecture and its components.
- CO2: Explain the basics of web development using PHP and HTML.
- CO3: Develop a program using functions, control structures and array.
- CO4: Demonstrate the concepts of object and exception handling in PHP.
- CO5: Demonstrate web application using PHP,XML and MYSQL.
- CO6: Develop a dynamic/ static websites with server side programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PSO1
CO2	PO1,PSO1
CO3	PO1,PO3,PSO2
CO4	PO1,PO3,PSO2
CO5	PO1,PO3,PSO2
CO6	PO1,PO3,PSO2

BCSG0800: PYTHON PROGRAMMING LAB

Objective: *This course introduces the solving of problems using Python programming using OO concepts and its connectivity with database.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	Programs based on the concepts of: • Building Python Modules • Obtaining user Data • Printing desired output Programs based on the concepts of: • Conditional if statements • Nested if statements • Using else if and elif Programs based on the concepts of Iteration using different kinds of loops Usage of Data Structures • Strings • Lists • Tuples • Sets • Dictionary Program based on the concepts of User-defined modules and Standard Library (random, numpy, scipy, sys, Math Module, String Module, List Module). Program based on Input Output. Program based on exception Handling. Program based on Simple Data analysis. Program based on Pandas.	26

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3.
Outcome: By the end of the course, students will learn to:

- CO1: Apply OO concepts using Python programming.
- CO2: Apply in-built packages defined in Python.
- CO3: Apply front-end as Python Programming to connect with any back-end.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO4

CO3	PO5/PSO2

BCSC0800: COMPUTER PROGRAMMING LAB

Objective: *The objective is to provide a comprehensive study of the C programming language. It stress the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	• Mapping of flow chart, Algorithm, Language • Simple C-program execution • Programs based on various operators • Programs based on Decision and case Control Structure • Programs based on Loop Control Structure • Program based on special control statement ➢ break ➢ continue • Programs based on Array Insertion, Deletion, Linear Search & Bubble Sort • Programs based on String ➢ Length, Copy, Reverse, Concatenate, Compare with & without built-in functions • Programs based on Functions. • Programs based on Storage Class. • Programs based on Recursion. • Programs based on Preprocessor. • Programs based on Pointers • Programs based on array • Programs based on string • Programs based on call by value and call by reference • Programs based on Dynamic Memory Allocation • Programs based on User Defined Data types ➢ Structure and Union ➢ Enum and Typedef • Programs based on File handling ➢ Opening a file ➢ Reading, writing and appending a file ➢ Closing file ➢ Random Access to Files of Records • Programs based on Command Line Argument.	52

Reference Books:

- Herbert Schildt, "C: The Complete Reference", 5th Edition, McGraw Hill Education.
- K. N. King, "C Programming a Modern Approach", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, "The C Programming Language", PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: On Completion of this course, students are able to:

- CO1: Design programs involving decision structures, loops and functions.
- CO2: Understand the concepts of functions, recursion, pointers and file handling.
- CO3: Design programs involving structures, union and functions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO3,PO4/PSO1
CO3	PO3/PSO2,PSO4

BCSC0801: OBJECT ORIENTED PROGRAMMING LAB

Objective: *The objective of this course is that students will study and learn Object Oriented Modeling and programming.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	Programs in Java and python based on the concepts of: • Classes, Constructors, Polymorphism and Keyword Static. Programs based on the concepts of: • Inheritance, Multithreading Using Thread Class & Interface Runnable, String Handling, Generic Classes. Programs based on the concepts of: • Handling Database Connectivity. • Implementation of Collection Framework. Programs based on the concepts of: • Database Connectivity. • Retrieving Data from Database. • Parameters Passing, Execute many Method. • Cursor Attributes. • Invoke Stored Procedures. • Invoke Stored Functions.	24

Reference Books:

- Naughton, Schildt, "The Complete Reference JAVA2", 9th Edition, Oracle Press.
- Bhave & Patekar, "Programming with Java", Pearson Education
- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:
- CO1: Implement object-oriented language features.
- CO2: Design GUIs and Graphical programming.
- CO3: Design object-oriented solutions for small systems involving database and event handling concepts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO5/PSO2
CO3	PO3,PO5/PSO4

BCSC0802: DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers.	24

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, "Database Management System", TMH

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Develop the SQL queries for real life scenarios.
- CO3: Implement the procedural language (PL/SQL) and Triggers.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO1,PO2/PSO1,PSO4
CO3	PO2,PO3,PO5/PSO2,PSO3

BCSC0803: OPERATING SYSTEMS LAB

Objective: *The lab aims to develop understanding the operation of UNIX operating system.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implement the following basic commands (with options) used in UNIX/LINUX OS. • Write and implement the basic vi editor commands. • Shell scripts that use simple commands. • Decision based Shell scripts. • Shell scripts related to strings. • Shell scripts using pipes. • Shell scripts with loop statements. • Demonstration and solution for race condition. • Demonstration and use of System Calls. • Implement the basics of IPC in UNIX.	24

Reference Books:

- SibsankarHalder and Alex a Aravind ," Operating Systems", 6th Edition, Pearson Education, 2009
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition , 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Implement the basic operations on UNIX operating systems.
- CO2: Demonstrate the working of systems calls.
- CO3: Demonstrate message passing in Unix operating system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO4,PO5/PSO1,PSO2

BCSC0804: COMPUTER ORGANIZATION LAB

Objective: *The aim of the lab is to better understand the design of sequential Circuits such as Flip-Flops, Registers, and Counters.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• Bread Board Implementation of Flip-Flops. • Experiments with clocked Flip-Flops. • Design of Counters. • Bread Board implementation of Counters &Shift Registers. • Implementation of Arithmetic Algorithms. • Bread Board implementation of Adder/Subtraction (Half, Full). • Bread Board implementation of Binary Adder. • Bread Board implementation of Seven Segment Display. • Small Project based on combinational and sequential circuit.	24

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4th **Edition**, Elsevier Publication, 2008.
- William Stalling , "Computer Organization",8th Edition, PHI,2011.
- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Implement the Combinational and Sequential Circuit.
- CO2: Demonstrate the working of counter and shift register.
- CO3: Demonstrate the working of ALU and seven segment displays.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO5/PSO2
CO2	PO3,PO4/PSO2
CO3	PO3,PO5/PSO1,PSO2

BCSC0805: DATA STRUCTURES & ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module		Lab
I &II	• Program to implement various operations in a singly linked list. • Program to implement insertion, deletion and traversal in a doubly linked List. • Program to implement polynomial addition using linked list. • Program to demonstrate the various operations on stack. • Program to convert an infix expression into postfix expression. • Program to evaluate a given postfix expression. • Program to implement Tower of Hanoi problem using Recursion. • Program to demonstrate the implementation of various operations on linear and circular queue. • Program to demonstrate the implementation of insertion and traversals on a binary search tree. • Program to implement Dijkstra's Algorithm to find the shortest path between source and destination. • Program to search a given element as entered by the user using sequential and binary search to search a given element as entered by the user. • Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.	24

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

BCSC0806: MICROPROCESSORS LAB

Objective: *The objective is to introduce the Architecture and programming of the microprocessor and learning about interfacing and various applications of microprocessor.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• To study 8085 microprocessor System. • To study 8086 microprocessor System. • To develop and run basic programs in 8085 ALP. • To develop and run programs in 8085 ALP related to the concept of looping, counting and indexing. • To perform interfacing of RAM chip to 8085/8086. • To perform interfacing of keyboard controller. • To perform interfacing of DMA controller. • To perform interfacing of UART/USART.	24

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- D. V. Hall , "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the arithmetic and logical operations using assembly language programming (8085).
- CO2: Demonstrate the memory operations using assembly language programming (8085).
- CO3: Demonstrate the interfacing of Keyboard, DMA and UART controller.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO2/PSO1,PSO2
CO3	PO1,PO3,PO5/ PSO2

BCSC0807: DESIGN & ANALYSIS OF ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours

I & II	• Implementation of sorting algorithms:
	  ○ Insertion Sort
	  ○ Bubble Sort
	  ○ Selection Sort
	  ○ Divide and conquer approach:
	• Quick Sort
	• Merge Sort
	  ○ Heap Sort
	  ○ Counting Sort
	• Implementation of Searching Techniques:
	  ○ Linear Search
	  ○ Binary Search
	• Implementation of Matrix Multiplication
	• Implementation of Convex Hull
	• Implementation of Breadth First Search
	• Implementation of Depth First Search
	• Implementation of Greedy approaches:
	  ○ Optimal Reliability Allocation.
	  ○ Knapsack. Minimum
	  ○ Minimum Spanning trees:
	• Prim's and Kruskal's algorithms.
	  ○ Single source shortest paths –
	• Dijkstra's and Bellman Ford algorithms.
	• Implementation of Dynamic Programming:
	  ○ Longest Increasing Subsequence.
	  ○ Finding best path in maze.
	  ○ Matrix Chain Multiplication
	  ○ 0/1 Knapsack Problem
	  ○ Resource Allocation Problem
		32

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.
- CO2: Demonstrate and use the appropriate data structures for a given problem
- CO3: Implement the algorithms based on Greedy approach and Dynamic Programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO1,PSO2,PSO4
CO2	PO1,PO3,PO4/PSO1,PSO2,PSO3

CO3	PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0900: WEB PROGRAMMING THROUGH PHP & HTML LAB

Objective: *This course introduces the building of dynamic web solutions using PHP programming and OO concepts and its connectivity with database.*

Credits: 01 **Semester IV** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I&II	Static web applications using HTML/CSS Web applications using HTML & Javascript Programs using Decision Control Structures Programs using Loop Control Structures Programs using user defined functions Programs of Array handling and manipulation Programs of File handling and manipulation Programs using OO concepts in PHP Web applications with Form handling at server Web applications for managing sessions Web applications with connectivity with MySQL Web applications manipulating XML file	24

Reference Books:

- IBM Student Guide on "Web Programming through PHP & HTML"
- Robin Nixon: "Learning PHP, MySQL and Javascript" "O'Reilly Media, Inc.", July 2009.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: By the end of the class, students will learn to:

- CO1: Design websites with interactive web page(s) using HTML, CSS and JavaScript
- CO2: Design a responsive web site using HTML and CSS.
- CO3: Develop simple web application using server-side PHP programing with backend as MySQL.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2,PO5/PSO1

Program Elective (Only for Specialization Programme)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Cloud Computing & Virtualization									
THEORY									
1.	BCSE0501	Introduction to IT Infrastructure Landscape	2	0	0	0	2	2	
2.	BCSE0502	Introduction to Virtualization and Cloud Computing	3	0	0	0	3	3	
3.	BCSE0503	Cloud Computing Architecture & Deployment Models	3	0	0	0	3	3	
4.	BCSE0508	Cloud and Business Process Management	3	0	0	0	3	3	
5.	BCSE0509	Cloud Security, Backup & Disaster Recovery	3	0	0	0	3	3	
6.	BCSE0510	Container Orchestration and Infrastructure Automation	3	0	0	0	3	3	
7.	BCSE0511	Devops	3	0	0	0	3	3	
PRACTICALS									
1.	BCSE0531	Virtualization Lab	0	0	2	0	1	2	
2.	BCSE0532	Cloud Deployment Lab	0	0	2	0	1	2	
3.	BCSE0536	Cloud and Business Process Management Lab	0	0	2	0	1	2	
4.	BCSE0537	Cloud Security, Backup & Disaster Recovery Lab	0	0	2	0	1	2	
5.	BCSE0538	Container Orchestration and Infrastructure Automation Lab	0	0	2	0	1	2	
6.	BCSE0539	DevOps Lab	0	0	2	0	1	2	
Total			**20**	**0**	**12**	**0**	**26**	**32**	

BCSE0501: INTRODUCTION TO IT INFRASTRUCTURE LANDSCAPE OVERVIEW

Objective: *The course enables students to understand the Database, Application and Middleware along with System Server hardware and Directory Services.*

Credits: 03 **Semester - III** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Storage Overview:** Storage Networking Technology, Types Of Storage System, FC-AL (Fiber Channel Arbitrated Loop), Fabric, Storage Area Network, Zoning, Storage Virtualization, hybrid storage networking technologies (iSCSI, FCIP, FCoE), **Systems & Directory Services Overview:** Server Technology, Operating System, Virtualization, Hypervisor, I/o Virtualization, Partitioning, Server Deployment, Server Management Console ,Server Availability Concepts And Techniques, Server Workload. Directory Server Concepts, Directory, LDAP PROTOCOL, Overview of LDAP, LDAP Architecture, LDAP Models, LDAP Replication Topologies, LDAP Data Inter change Format (LDIF). **Database Overview:** Data Warehousing, And Data Marts, Data Mining (DM), Data Warehousing and Data Marts	20
II	**Network Security and Overview:** Network Overview, Network Topologies, Tree Topology, Firewalls, Switching Concepts, What Is Routing?, Virtual Lan's, Security Basics, Loss Of Privacy, Loss of Integrity, Security Technology, Active Audit , Secure Messaging, Data Security, Network Security. Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, Hyper jacking. **Application and Middleware Overview :** Introduction To Common Messaging System (MQ SERIES), Application Integration – Business Need, Middleware, Message Oriented Middleware ,Synchronous interaction, Asynchronous interaction, Coupling, Reliability ,Scalability, Availability, IBM WebSphere MQ, WebSphereMQ Objects, Web TierDeployment, Application Servers And Clustered Deployment, EMAIL ,Lotus Architecture, Lotus Domino Server Types, Lotus Notes Clients, Types of Certificates. **Server Architectures:** Stand-alone, blades, stateless, clustering, scaling, Limitation of traditional server deployments, Redundant Layer 2 and Layer 3 designs.	20

Text Book:

- Introduction to IT infrastructure Landscape (IBM ICE Publication)
- Avi Silberschatz, Henry F. Korth, S. Sudarshan , Database System Concepts, Sixth Edition, 2010.
- Vmware "VMware Security Hardening Guide" White Paper, June 2011.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO4,CO4,CO5,CO6,CO7.

Outcome: After completion of course, the student will be able to:

- CO 1: Understand the basics of Storage area Network and types of storage.
- CO2: Understand the concept of server technology ,Virtualization, Hypervisor.
- CO3: Understand LDIF architecture, LDAP Protocol and LDAP models.
- CO4: Explain the basics of Database ,Data warehousing and data mining.
- CO5: Explain the different topologies and security technology.
- CO6: Understand application integration, middleware and lotus architecture.
- CO7: Understand server architecture (blades, clustering, scaling, server deployments).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO1/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1
CO6	PO1/PSO1
CO7	PO1/PSO1

BCSE 0502: Introduction to Virtualization and Cloud Computing

Objective: *The course enables students to understand the virtualization technology, Applications along with cloud computing concepts and services.*

Credits: 03 **Semester - IV** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Virtualization:** Overview of Virtualization: Need of Virtualization, traditional IT Infrastructure, shortcoming of physical infrastructure, benefit of Virtualization, comparison of traditional IT infrastructure with virtualized infrastructure. **Virtualization:** Implementing Virtualization, typical hardware / software server stack and its logical equivalence, pre/post virtualization server stack, types of virtualization, area and technology based classification, history of virtualization, time sharing system, IBM mainframe and PowerVM virtualization, Extending Virtualization to x86 and its hardware support, impact of Virtualization: cost and manageability impact. **Server and Storage Virtualization:** Types of Server Virtualization, simulation, Hardware Assisted Virtualization, Hypervisors, Ring levels on x86 processors, types of Hypervisors, IBM PowerVM Hypervisors, common consideration in server Virtualization, Desktop Virtualization: Benefits Constraints and Types. Anatomy of server Virtualization, three major layers in Xen server, storage Virtualization overview: benefit and types, features of logical layers, Host level storage Virtualization, host based mirroring, storage level Virtualization, network based storage Virtualization. **Network and Application Virtualization:** Network Virtualization overview: VPN,VLAN, challenges in using application in traditional install, use and update model, solution for challenges, Architecture, benefits of Application Virtualization.	20
II	**Introduction to Cloud Computing:** Overview: Introduction to cloud computing, service driven model, advantage of cloud computing: marketing point of view, types of services, OS and Virtualization, VM, advantage of Virtualization, Virtualization and cloud and its overlapping, business value, business impact of cloud, technological value of cloud, end user benefits, change for provider and administrator, pros and cons of cloud model, anatomy of cloud, solution component, service catalog, user self-service portal, service request management, provisioning, optimized infrastructure, chargeback, benefit of cloud, delivery and deployment model, different cloud architecture: public, private and hybrid and its pros and cons, delivery models. Cloud transformation roadmap, history of cloud, Clint-server, cluster, grid models, cloud vs grid and their relationship, cluster and cloud, utility computing and evolution of cloud computing, cloud computing. Milestones. **Cloud Deployment selection criteria:** Pros and cons of each Deployment architecture of Cloud: Public, Private, Hybrid, cloud deployment decision factors(Business IT Control, Business critical application, data and transaction security, compliance and audit, balance of CAPEX and OPEX, workload characteristics, workload lifespan preferences, Industry segment- SME and Large enterprises, Data Freedom, software characteristics, time to deploy), Public Cloud: factor matrix, advantage, disadvantage, Public Cloud: Factor Matrix, advantage and disadvantage, Hybrid Cloud: factor matrix, advantage, disadvantage, Overview of Cloud delivery models, infrastructure, IT Layers, IaaS Overview, features, cloud bursting, multi tenancy, resource pooling, PaaS: overview, component, example, SaaS: advantage, example. **Implementation of Virtualization and Factors deciding Cloud workloads :** Case study overview, customer IT landscape, function of data center, trigger for virtualization, preparation for virtualization, server selection, server sizing,	20

	server criticality, provisioning, proximity and locality, transition tool for virtualization, cost savings, cloud workload overview, workload characterization, factors, suitable workload for cloud, private cloud solution, types of workload, advantage, mission critical workload, mixed workload, production only workload for hybrid cloud, industry specific workload , non suitable workload: public, private cloud, possible workload by cloud.	

Text Books:

- R1. Introduction to Virtualization and Cloud Computing(IBM ICE Publication)
- R2. Cloud Computing Black Book (by : Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah)
- R3. Raj Kumar Buyya, James Broberg, Andrezei M.Goscinski , Cloud Computing: Principles and paradigms, 2011.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of virtualization technology and hypervisors.
- CO2: Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
- CO3: Recognize real-world problem using cloud computing through group collaboration.
- CO4: Understand on-demand utility computing phenomenon of cloud computing.
- CO5: Understand the issues involved in cloud computing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO7/PSO2
CO2	PO1,PO3,PO5,PO7/PSO4
CO3	PO1,PO3,PO7/PSO1
CO4	PO1,PO7/PSO1
CO5	PO1,PO3/PSO1
CO6	PO1,PO3,PO5,PO7/PSO4

BCSE0531: VIRTUALIZATION LAB

Objective: *This course covers aims to explain various technologies related to Cloud Computing and their practical implementations, discuss different architectural models of cloud computing, the concepts of virtualization and cloud orchestration.*

Credits: 01 **Semester IV** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I&II	1. Introduction and Installation of VMware. 2. Installation of Ubuntu, CentOS on VMware. 3. Exercise on virtual Machine using QEMU. 4. Installation of windows, CentOS on QEMU. 5. Exercise on KVM on Ubuntu 6. Installation of windows, CentOS on KVM. 7. Exercise on KVM on CentOS. 8. Introduction and simulation with packet tracer. 9. Exercise on installation of VMware ESXi Server on VMware. 10. Creating and assigning instances using ESXi server on VMware. 11. Creating an EC2 instance on AWS 12. Configuration of db in AWS. 13. Creation of S3 bucket with single IAM user in AWS.	18

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO4.

Outcome: After completion of the course, student will be able to:

- CO1: Design Virtual Machines over Type-2 Hypervisor & Test Client Server application over VMs created.
- CO2: Apply and analyze various kinds of networking in virtual environment.
- CO3: Apply and create various use cases of the key components of AWS.
- CO4: Understanding, installation of Type-1 hypervisor and assignment of instances on ESXi server.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5/PSO2
CO2	PO1,PO2,PO3,PO5/PSO1
CO3	PO1,PO3,PO5,PO7/PSO2
CO4	PO1,PO2,PO3,PO5/PSO2

BCSE 0503: CLOUD COMPUTING ARCHITECHURE & DEPLOYMENT MODELS

Objective: The objective is to study the architecture and deployment models to develop a private cloud using the open standards tools such as open stack.

Credits: 03 **Semester - V** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Definition of cloud computing, Delivery Models, Conceptual reference model, Cloud Computing solution components. **Cloud computing Architecture:** The conceptual reference model, Service Deployment, Cloud service management, cloud taxonomy, IBM CCRA, Common cloud management platform. **Case Study:** IBM Smart Cloud Entry, VMware vClouddirector. **Cloud vendor selection:** SLA, Security and privacy, periodic update and maintenance, data location and Jurisdiction, Measurability, Pricing, Interoperability and lock in , Exit process, track record. **OpenStack:** Definition, Advantages, Releases, Architectural overview, Different components of Open Stack.	20
II	**OpenStack:** Open stack- Hypervisors, Network Services, Storage -Block Storage, Object Storage, Choosing Storage Backends, Commodity Storage Backend Technologies: swift, Ceph, Gluster, LVM, ZFS. **Advance concepts in Openstack:** Multiserver Openstack, Tenant model architecture, Cloud orchestration using OpenStack using OpenStack Heat and Ubuntu Juju. **Eucalyptus:** Introduction, Features and Functionality, Architecture, Basic and Advanced Components. Eucalyptus vs Openstack **OpenNebula:** Introduction, Features and Functionality, Architecture, Basic and Advanced Components. OpenNebula vs Openstack	20

Text Book:

- Cloud Computing Architecture & Deployment Models (IBM Publications-),2015.
- Raj Kumar Buyya, James Broberg, AndrezeiM.Goscinski , Cloud Computing: Principles and paradigms, 2011.

Reference Book:

- Rittinghouse, John, W, " Cloud computing ": Implementation, management and security.
- Barrie Sosinsky , "Cloud Computing Bible", Wiley, 2011.
- Bumgardner, V. C. , OpenStack in action. Manning PublicationsCompany, 2016.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO4,CO5,CO6.

Outcome: After completion of course, the student will be able to:

- CO1: Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS and different clouds.
- CO2: Explain the components of Conceptual Reference Models like NISTand IBM CCRA.
- CO3: Understand the components and drafting of SLA.
- CO4: Explain the Architecture and Components of Openstack.
- CO5: Understand concepts of storages exist in the cloud environment like swift, Ceph, Gluster, LVM, ZFS.
- CO6: Understand the private cloud tools like OpenNebula and Eucalyptus.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/PSO1
CO2	PO1/PSO1
CO3	PO1/PSO1
CO4	PO1,PO2/PSO2
CO5	PO1/PSO1
CO6	PO1,PO2,PO5/PSO1

BCSE0532: CLOUD DEPLOYMENT LAB

Objective: *This course covers aims to explain various technologies related to Cloud Computing deployment models and their practical implementations, discuss different architectural models of cloud computing, the concepts of virtualization and cloud orchestration.*

Credits: 01 **Semester V** **L–T–P : 0–0–2**

Module No.	Content	Teaching Hours
I&II	Case Study of Public Cloud service provide: IBM Cloud Case Study of Public Cloud service provide: AWS Case Study of Public Cloud service provide: Azure Implementation of OpenStack using VMware Implementation of OpenStack on CentOS machine Deploying VM on Open Stack platform Building applications on VM in OpenStack platform	18

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of Lab, student will be able to:

- CO1: Understand the Architecture and Components of IBM Cloud, AWS and Azure.
- CO2: Implement Openstack using VMware and CentOS machine.
- CO3: Implement of automation tools like Terraform and heat to create resources in AWS and Openstack environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO7/PSO1,PSO2
CO2	PO1,PO3,PO5/PSO1,PSO2
CO3	PO1,PO3,PO5,PO7/PSO1,PSO2

BCSE 0508: CLOUD AND BUSINESS PROCESS MANAGEMENT

Objective: *This course introduces the cloud monitoring, Service Management, System Administration and Business Process in Cloud Computing.*

Credits: 03 **Semester V** **L–T–P-J: 3–0-0-0**

Module No.	Content	Hours
I	**Service management & Service administration in Cloud:** Cloud Architecture, Aneka Cloud Architecture, General Architecture of Cloud Workflow Systems, Cloud Provisioning, Cloud-based Infrastructure Service Provisioning, Cloud Usage Monitor, Monitoring Agent, Resource Agent, Polling Agent, Key Benefits and features, Cloud monitoring and features, Metering and Billing, Smart Metering-Architecture, **Cloud Computing Services:** Cloud Computing Administration, Cloud Computing Solution for Enterprise, Public and Private Cloud for Enterprise. **Cloud Growth Planning & Managing Security and Resiliency:** Forecasting requirements for cloud managed resources. The IBM Cloud Computing Reference Architecture(CCRA), High Availability and Interoperability, **Operational view for cloud management**: IBM Smart Cloud, Integrated Infrastructure for Service Providers, Storefront, IBM Ecosystem Support, Cloud service provider deployment scenarios. **Service Catalog Management**: Service Catalog-Value to the Business, Basic Troubleshooting Techniques, Configuration Management –Principles.	20
II	**Cloud computing BPM:** Market Benefits Business Process Management Life Cycle Business model, Business process modeling tools. **Introduction to BPM:** Motivation and Definitions. Business Process-Process Designer. Administration and Stakeholders. Classification of Business Processes. Goals, Structure, and Organization. **PC Health Check:** What slows down a computer?, Running a PC Health Check, Patching and Updates, Tools for patch management, Patching demands proper due Diligence, Patch Management **BPM Life Cycle Methodology**: Business Process Management Activities BPM suites Practice BPM technology Managing end-to-end, customer-facing processes Establishing a common language for business IT alignment. **Business Process Management Overview**: Business process management overview. Overview of process modeling, Building processes in IBM BPM Reusing items in Process Designer. Creating a business process definition (BPD) Building services. **Creating User Interfaces**: Creating user interfaces. Coaches. Developing reusable Coach Views Templates. Stock controls. **Dashboards and Reports Business value**: Solution overview. IBM Solution for Collaborative Lifecycle Management. Designing process interactions for business users	20

Reference Books:

- IBM Student Guide on "Managing the Cloud".
- IBM Student Guide on "Business Process Management".
- Rajkumar Buyya "Mastering Cloud Computing".

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Understand basics of cloud Storage systems.
- CO2: Explain the technologies and approaches for the business related issues.
- CO3: Understand the operation view and service catalog of cloud management.
- CO4: Understand the concepts of VPM cloud computing.
- CO5: Designprocess interactions interface for business users.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO1/PSO1
CO4	PO1/PSO1
CO5	PO1,PO3/PSO1

CSE0536: CLOUD AND BUSINESS PROCESS MANAGEMENT LAB

Objective: *This course introduces the Management of Cloud in terms of IT service Management and monitors the performance of data centers with the help of cloud computing simulators.*

Credits: 01 **Semester V** **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I&II	Performance evaluation of services over Cloud. Management of cloud resources using Cloud Analyst. Simulation of large scale Cloud computing data centers with Cloud Analyst. Creating a Super User on Linux OS and learn access control. Creating a Warehouse Application in SalesForce.com. Stop and start Amazon EC2 instances at regular intervals using Lambda. Installation &Hands on practice on CloudSim Create smart AWS diagrams using CloudCraft for a business process. Building an Amazon CloudWatch dashboard outside of the AWS Management Console. Create an IAM User with Full Access to Amazon S3 and CloudWatch Logs	24

Reference Books:

- IBM Student Guide on “Managing the Cloud”.
- IBM Student Guide on “Business Process Management”
- A. Srinivasan, “Cloud Computing: A Practical Approach for Learning and Implementation”

Focus: This Course focuses on Employability under CO1,CO2,CO3.
Outcome: After completion of course, the student will be able to:

- CO1: Analyze different cloud programming platforms and tools.
- CO2: Develop scalable applications using AWS features.
- CO3: Demonstrate the working of CloudSim.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PSO1
CO2	PO1,PO2,PO3,Po5/PSO1,PSO2
CO3	PO1,PO3,PO5/PSO1

BCSE 0509: CLOUD SECURITY, BACKUP AND DISASTER MANAGEMENT

Objective: *The course objectives is to introduce about the needs and application of security, backup and disaster management in cloud computing.*

Credits: 03 **Semester V** **L–T–P-J: 3–0–0-0**

Module No.	Content	Hours
I	**Cloud Computing Software Security Fundamentals:** Introduction to Cryptography, Cloud Information Security Objectives, Confidentiality, Integrity, and Availability, **Cloud Security Services:** Authentication, Authorization, Auditing, Accountability. Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Approaches to Cloud Software Requirements Engineering, Secure Cloud Software Testing. **Cloud Computing Security Challenges:** Security Policy Implementation, Policy Types, Regulatory Policies, Informative Policies, Computer Security Incident Response Team, Virtualization Security Management, Virtual Threats, Hypervisor Risks, Increased Denial of Service Risk, VM Security Recommendations, Best Practice Security Techniques, VM-Specific Security Techniques, Hardening the Virtual Machine, Securing VM Remote Access. **Infrastructure Security**: The Network Level, The Host Level, The Application Level **Data Security And Storage:** Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security **Identity And Access Management**: Trust Boundaries and IAM, Why IAM?, IAM Challenges, IAM Definitions, IAM Architecture and Practice, CloudWatch, Cloud Trail	20
II	**Backup:** Recovery Objectives: RPO, RTO, Types of Backup, Architecture of Backup. **Data Preparation for Backup**: Data Compression, Data Deduplication, Archive, Data Protection in a virtualized environment, Cloud based Data Protection. **Fundamentals of Availability:** Introduction, Reliability, Serviceability, Need of Availability. **High Availability:** Components that affect Availability & need for High Availability, Availability Levels and how it is achieved, Single system, fault tolerant, HA clustering & components, Types of HA Solutions, HA Clustering Advantages. **HA Criteria and Applications:** Network layer HA, Hardware combination & HA Possibilities, Applications & Operating system layer. Hardware layer: Storage, HA for Virtual Environment, Components of Virtual Machine and HA on Virtual Machines. **Fundamental of Disaster Recovery:** Disaster Recovery, Types of Disasters, Business Continuity (BC) & Disaster Recovery (DR), Importance of Disaster Recovery, DR Terminologies, Disaster Recovery Planning, Phases of Planning, DR Technology Tree, Virtualization.	19

Reference Books:

- IBM Book , "Cloud Backup & DR", 2016.
- Robin M Hostings , "Planning Cloud-Based Disaster Recovery for Digital Assets" : The Innovative Librarian's Guide, 2017.
- Bryan Strawser, "Rethinking Disaster Recovery": The Impact of Cloud Computing (Bryghtpath LLC White Papers Book 2), 2016.
- IBM Book, "Cloud Security", 2016.
- William Stallings. "Cryptography and network security", 7/E. Pearson Education India, 2019.
- Chris Doston, ," Practical Cloud Security", F/E, O'Reilly, 2019

- Tim Mather, Subra Kumaraswamy, and Shahed Latif , "Cloud Security and Privacy", 3/E O'Reilly, 2019.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the concepts of Cloud Security.
- CO2: Identify the known threats, risks, vulnerabilities and privacy issues associated with Cloud based services.
- CO3: Evaluate the security controls necessary to ensure confidentiality, integrity and availability in cloud computing.
- CO4: Design & develop backup strategies for cloud.
- CO5: Understand the concept of High availability.
- CO6: Apply the concept of disaster recovery planning in cloud computing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1,PO3,PO5/PSO4
CO3	PO1,PO2,PO5/PSO4
CO4	PO1,PO2,PO3/PSO1
CO5	PO1/PSO1
CO6	PO1/PSO1

BCSE0537: CLOUD SECURITY, BACKUP & DISASTER RECOVERY LAB

Objective*: To cover the basic security prespective in cloud computing*

Credits: 01 **Semester VI** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I&II	1. Write a program to perform encryption and decryption 2. using the Ceaser Cipher algorithm. 3. Write a program to perform encryption and decryption 4. using the Substitution Cipher algorithm. 5. Write a program to implement RSA Algoithm 6. Write a Java program to implement DiffieHellman Key exchange Algoithm 7. To implement MFA in AWS 8. To create multiple users in CSP using IAM service roles. Assign different users different priveldges. 9. To implement Protect instances with AWS Virtual Private Cloud (VPC) 10. To Create outer firewall instance fwout 11. Configure routing tables on machines in the DMZ system 12. To implement a Brute fore Attack 13. To perform a SQL Injection attack 14. To implement Space Steganography 15. To implement Text Steganography **16.** To implement Image Steganography	12

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome:

- CO1: Understand the basics of Steganography techniques.
- CO2: Analyzing the effects of various attacks.
- CO3: Install the peripherals in a Cloud scenario with respect to Systems and Network Security.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PSO1,PSO2
CO2	PO1,PO2,PO3/PSO4
CO3	PO1,PO3,PO5/PSO2

BCSE0538:CONTAINER ORCHESTRATION & INFRASTRCTURE AUTOMATION LAB

Objective: *This course introduces the hands on practice with Docker, Kubernetes and Jenkins open source containerization platform in cloud computing.*

Credits: 01 **Semester VI** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	Installation of Docker Get familiar with Docker basic Commands Docker images and docker containers How to run Jenkins on Docker Container? How to create Docker Compose File? How to create Docker Volume? How to create Docker Swarm? Hands-on practice on Kubernetes Create first Kubernetes Application	24

Reference Books:

- IBM Student Guide on "Container Orchestration & Infrastructure Automation Lab".
- A. Srinivasan, "Cloud Computing: A Practical Approach for Learning and Implementation"

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: By the end of the class, students will learn to:

- CO1: Understand different cloud programming platforms and tools.
- CO2: Understand how to use Docker Containers.
- CO3: Develop the scalable applications using Kubernetes.
- CO4: Understand the basic concepts of Docker images and Docker Repository.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5/PSO3
CO2	PO2,PO3,PO4/PSO1
CO3	PO1,PO3,PO4/PSO2
CO4	PO1,PO2/PSO3,PSO4

BCSE0510:CONTAINER ORCHESTRATION & INFRASTRUCTURE AUTOMATION

Objective: *This course introduces the Docker, Kubernetes and micro-services in Deploy applications to production environment in Cloud Computing.*

Credits: 03 **Semester VI** **L–T–P-J: 3–0–0-0**

Module No.	Content	Hours
I	**Docker Fundamentals:** What is Docker?What isn't Docker? Server virtualization, Advantages of Docker, Is Docker a virtual machine? How does it help the developers? Why use Docker as a developer? Docker uses containers, why organizations embrace Docker containers? Containerdriven workloads, Substitutes for hypervisors, Utilizing micro services, Virtualization and containerization comparison, Convergence of containerization and virtualization, Containerization innovations, Overview of Docker editions, Installation of the Docker engine, Docker terminology, Docker community, Docker community edition, Docker enterprise edition, Build Kit features, Docker compose Container, Docker example, Let's understand Docker, Docker startup Docker and DevOps tools, Docker architecture Docker host, Understanding microservices, microservices architecture Docker components overview, Dockerize your applications, Docker for IBM Cloud, Containerization vs virtualization, Application containerization advantages and disadvantages, Running your own Docker container, Docker desktop for windows platform, Checking docker version, Running your first NGINX application, Docker repository,Docker tags, Docker TAG examples, Docker images, Managing containers and images, Docker volumes, Docker volumerelated commands, Docker volume drivers, Networking in Docker, Docker network types, Creating and inspecting a network, Summarize Docker Networking, Build a continuous Docker integration pipeline, CI workflow, Open network ports and protocols for communication, GitHub settings, Web-hooks and services.	20

II	**Configuring the Jenkins**: Test job configuration, Shell commands, Automation and orchestration, Key concepts in orchestration, Popular orchestra platforms: Swarm Docker, Kubernetes, Apache mesos, Container orchestration survey, Container adoption, Defining the functionality of container orchestration, Defining containers as a service function, Products/services used for container management and orchestration, Reducing container control by using configuration management tools, Orchestration primary method, Top orchestration products, Expected top orchestration products, Service discovery tools, Planning tools, Cluster management **What is Kubernetes?:** Clusters and architecture, Docker file instructions: CMD, Benefits, Kubernetes and DevOps, Kubernetes vs Docker, Kubernetes and IBM, Kubernetes architecture, Decentralized approach, Dynamic grouping, Kubernetes structure, Essential characteristics for manageability, API discovery and translation, Life of a request, API server internals, Bakery as a foundation, Defining the model of a bakery, Bakery standards, Bakery interactions, Bakery model practices discovery and implementation, Global bakery through automation, Cluster applications in a public cloud for Kubernetes, Kubernetes NWay active redundancy model, Top orchestration products, Configuration management and orchestration, Styles of workload orchestration, Container orchestration: Herding computational cattle, Emerging containers as a service marketplace, What is continuous delivery, DevOps culture, Docker, Jenkins and continuous delivery, Automation perspective, NexGen CI: Jenkins on docker, NexGen CD: Orchestrating docker, Blend of Jenkins with workflow, Container orchestration, Where in the system stack does the container orchestration fit?Tools available for container orchestration, Comparison to tracking containers without using an orchestration system, Continuous Integration/Continuous Deployment (CI/CD)	20

Reference Books:

- IBM Student Guide on "Container Orchestration and Infrastructure Automation".
- RajkumarBuyya "Mastering Cloud Computing".

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO4.

Outcome: By the end of the class, students will learn to:

- CO1: Understand to solve problems that demonstrate how to use containers for your applications.
- CO2: Running containers in production and how to solve problems of advanced orchestration such as high availability, service discovery, and reconciliation in Cloud Computing.
- CO3: Evaluate whether Docker is an appropriate containerization platform for you.
- CO4: Describe how the components of Docker containers support compute container

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PSO1
CO2	PO2,PO3,PO4/PSO4
CO3	PO1,PO5/PSO2
CO4	PO1,PO2/PSO3

GLA University, Mathura (U.P.)

Institute of Engineering and Technology

Department of Computer Engineering & Applications (CEA)

Course: B.Tech. (CSE)

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Program Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals, researchers or entrepreneurs, for developing sustainable solutions.

PEO2: Attain positions of leadership in an organization and /or on teams.

PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Program Specific Outcomes (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.

PSO2: Design and develop hardware and software interfaces along with latest tools and technology to meet the needs of industry.

PSO3: Analyze the algorithmic principles, theory of computation and mathematical foundations for the modeling and design of computing systems.

PSO4: Apply knowledge to provide innovative solutions to existing problems and identify research gaps.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics and science, with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE.

PO2: Problem Analysis: Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of solutions: Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations.

PO4: Conduct Investigations of Complex problems: Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development

PO8: Ethics: Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

PO12: Life-Long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change.

Contribution ***1: Reasonable*** ***2:Significant*** ***3: Strong***

Mapping of Programme Educational Objectives with Programme Outcomes

A broad relation between the Programme Objective and the outcomes is given in the following table:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
PEO1	3	3	2	3	3	2	2	1	2	3	2	2
PEO2	3	3	3	2	2	3	3	3	3	3	3	2
PEO3	3	2	2	3	3	3	3	1	2	2	1	3

Mapping of Program Specific Objectives with Programme Outcomes

A broad relation between the Program Specific Objectives and the outcomes is given in the following table:

PROGRAM SPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
PSO1	3	3	3	3	3	2	1	1	3	3	1	2
PSO2	3	3	3	2	3	2	1	1	3	3	2	2
PSO3	3	3	2	3	3	2	2	1	3	3	1	2
PSO4	3	3	3	3	3	2	1	2	3	3	3	3

COURSE STRUCTURE

B.TECH.

COMPUTER SCIENCE & ENGINEERING

Under

Choice Based Credit System (CBCS)

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BCHS0101/ BPHS0001	Engineering Chemistry/ Engineering Physics	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication I	2	0	0	2	2
4.	BEEG0001/ BECG0001	Basic Electrical Engineering / Electronics Engineering	3	1	0	4	4
5.	BCSC0001	Computer Programming	4	1	0	5	5
PRACTICALS							
6.	BCHS0801/ BPHS0801	Engineering Chemistry Lab / Engineering Physics Lab	0	0	2	1	2
7.	BELH0801	English Language Lab I	0	0	2	1	2
8.	BEEG0800/ BECG0800	Electrical Engineering Lab/ Electronics Lab I	0	0	2	1	2
9.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
10.	BCSC0800	Computer Programming Lab	0	0	2	1	2
		TOTAL	**15**	**4**	**10**	**24**	**29**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BPHS0001/ BCHS0101/	Engineering Physics/ Engineering Chemistry	3	1	0	4	4
3.	BELH0002	English Language Skills for Communication II	2	0	0	2	2
4.	BECG0001/ BEEG0001	Electronics Engineering/ Electrical Engineering	3	1	0	4	4
5.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
6.	BCSG0001	Python Programming	4	1	0	5	5
PRACTICALS							
7.	BPHS0801/ BCHS0801	Engineering Physics Lab/ Engineering Chemistry Lab	0	0	2	1	2
8.	BELH0802	English Language Lab II	0	0	2	1	2
9.	BECG0800/ BEEG0800	Electronics Lab I/ Electrical Engineering Lab	0	0	2	1	2
10.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1	2
11.	BCSG0800	Python Programming Lab	0	0	2	1	2
		TOTAL	**18**	**5**	**10**	**28**	**33**

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
THEORY									
1.	BCSC0001	Computer Programming	4	1	0	0	5	5	
2.	BCSC0002	Object Oriented Programming	3	0	0	0	3	3	Programming
3.	BCSC0003	Database Management System	3	0	0	0	3	3	
4.	BCSC0004	Operating Systems	3	0	0	0	3	3	
5.	BCSC0005	Computer Organization	3	0	0	0	3	3	
6.	BCSC0006	Data Structures and Algorithms	3	1	0	0	4	4	Programming
7.	BCSC0007	Introduction to Microprocessors	3	0	0	0	3	3	Computer Organization
8.	BCSC0008	Computer Networks	3	1	0	0	4	4	
9.	BCSC0009	Software Engineering	3	0	0	0	3	3	
10.	BCSC0010	Discrete Mathematics	3	1	0	0	4	4	
11.	BCSC0011	Theory of Automata and Formal Language	3	1	0	0	4	4	
12.	BCSC0012	Design and Analysis of Algorithms	3	0	0	0	3	3	Programming, Data Structures
13.	BCSC0014	Applied Database Management System	4	0	0	0	4	4	
14.	BCSC0015	Applied Data Structures and Algorithms	4	1	0	0	5	5	
PRACTICALS									
1.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
2,	BCSC0801	Object Oriented Programming Lab	0	0	2	0	1	2	Programming Lab
3.	BCSC0802	Database Management System Lab	0	0	2	0	1	2	
4.	BCSC0803	Operating Systems Lab	0	0	2	0	1	2	
5.	BCSC0804	Computer Organization Lab	0	0	2	0	1	2	
6.	BCSC0805	Data Structures and Algorithms Lab	0	0	2	0	1	2	Programming Lab
7.	BCSC0806	Microprocessors Lab	0	0	2	0	1	2	
8.	BCSC0807	Design and Analysis of Algorithms Lab	0	0	2	0	1	2	Programming, Data Structures
9.	BCSC0808	Applied Database Management System	0	0	2	0	1	2	
10	BCSC0809	Applied Data Structures and Algorithms	0	0	2	0	1	2	
Total			**45**	**6**	**20**	**0**	**61**	**71**	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Computer Network and Security									
THEORY									
1.	BCSE0001	Network Programming and Management	3	0	0	0	3	3	Computer Networks
2.	BCSE0002	Principles of Mobile Computing	3	1	0	0	4	4	Computer Networks
3.	BCSE0003	Ad Hoc Networks	3	0	0	0	3	3	Computer Networks
4.	BCSE0004	Cryptography and Network Security	3	0	0	0	3	3	Computer Networks
5.	BCSE0005	Cyber security and Digital Forensics	3	0	0	0	3	3	Computer Networks
6.	BCSE0006	Information Coding Techniques	3	0	0	0	3	3	Computer Networks
PRACTICALS									
1.	BCSE0070	Network Programming and Management Lab	0	0	2	0	1	2	Computer Networks
2.	BCSE0071	Cryptography and Network Security Lab	0	0	2	0	1	2	Computer Networks
3.	BCSE0072	Information Coding Techniques Lab	0	0	2	0	1	2	Computer Networks

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
Bouquet: Software Engineering									
THEORY									
1.	BCSE0051	Software Quality Engineering	3	0	0	0	3	3	Software Engineering
2.	BCSE0052	Service Oriented Architecture	3	0	0	0	3	3	Software Engineering
3.	BCSE0053	Agile Software Development	3	0	0	0	3	3	Software Engineering
4.	BCSE0054	Software Project Management	3	0	0	0	3	3	Software Engineering
5.	BCSE0055	Software Testing	3	0	0	0	3	3	Software Engineering
6.	BCSC0013	Compiler Design	3	1	0	0	4	4	Theory of Automata & Formal Language

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Image Processing and Intelligent System									
THEORY									
1.	BCSE0101	Digital Image Processing	3	0	0	0	3	3	Mathematics, Programming
2.	BCSE0102	Computer Graphics And Multimedia	3	1	0	0	4	4	Mathematics, Programming
3.	BCSE0103	Soft Computing	3	0	0	0	3	3	Discrete Mathematics
4.	BCSE0104	Artificial Intelligence	3	0	0	0	3	3	Data Structures
5.	BCSE0105	Machine Learning	3	0	0	0	3	3	Mathematics, Programming
6.	BCSE0106	Machine Learning And Its Applications	3	0	0	0	3	3	Mathematics, Programming
PRACTICALS									
1.	BCSE0131	Digital Image Processing Lab	0	0	2	0	1	2	Programming
2.	BCSE0132	Soft Computing Lab	0	0	2	0	1	2	Programming
4.	BCSE0133	Machine Learning Lab	0	0	2	0	1	2	Programming
PROJECTS									
1.	BCSE0141	Machine Learning Project	0	0	0	-	2	-	Programming

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
Bouquet: Advanced Data Processing									
THEORY									
1.	BCSE0151	Advanced Concepts in Database Systems	3	0	0	0	3	3	DBMS
2.	BCSE0152	Data Mining and Warehousing	3	0	0	0	3	3	DBMS
3.	BCSE0153	Business Intelligence	3	0	0	0	3	3	DMW
4.	BCSE0154	Information Retrieval System	3	0	0	0	3	3	DATA STRUCTURE
5.	BCSE0155	Distributed and Parallel Databases	3	0	0	0	3	3	DBMS
6.	BCSE0156	Natural Language Processing	3	0	0	0	3	3	TAFL/Compiler Design
7.	BCSE0157	Introduction to Big Data Analytics	3	0	0	0	3	3	DBMS
8.	BCSE0158	Big Data Analytics	3	0	0	0	3	3	
PRACTICALS									
1.	BCSE0181	Data Mining and Warehousing Lab	0	0	2	0	1	2	
2.	BCSE0182	Business Intelligence Lab	0	0	2	0	1	2	
3.	BCSE0183	Big Data Analytics Lab	0	0	2	0	1	2	
PROJECTS									
1.	BCSE0191	Business Intelligence Project	0	0	0	-	2	-	
2.	BCSE0192	Big Data Analytics Project	0	0	0	-	2	-	Programming

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: High Performance Computing									
THEORY									
1.	BCSE0201	Advanced Computer Architecture	3	0	0	0	3	3	Computer Organization
2.	BCSE0202	Embedded System	3	0	0	0	3	3	Microprocessors
3.	BCSE0203	Internet of Things	3	0	0	0	3	3	Microprocessors
4.	BCSE0204	Internet of Things And Its Applications	3	0	0	0	3	3	
5.	BCSE0205	Distributed System	3	0	0	0	3	3	CN /OS
6.	BCSE0206	Parallel Algorithms	3	0	0	0	3	3	CO & Algorithms
7.	BCSE0207	Cloud Computing	3	0	0	0	3	3	
8.	BCSE0208	Cloud Computing and Virtualization	3	0	0	0	3	3	
PRACTICALS									
1.	BCSE0231	Embedded System Lab	0	0	2	0	1	2	
2.	BCSE0232	Internet of Things Lab	0	0	2	0	1	2	
3.	BCSE0233	Parallel Algorithms Lab	0	0	2	0	1	2	
4.	BCSE0234	Cloud Computing lab	0	0	2	0	1	2	
PROJECTS									
1.	BCSE0241	Internet of Things Project	0	0	0	-	2	-	
2.	BCSE0242	Cloud Computing And Virtualization Project	0	0	0	-	2	-	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Development Tools and Technologies									
THEORY									
1.	BCSE0251	Full Stack Using Scripting Technologies	3	0	0	0	3	3	
2.	BCSE0252	Full Stack Using Node JS	3	0	0	0	3	3	
3.	BCSE0253	Full Stack Using C#.net	3	0	0	0	3	3	
4.	BCSE0254	PHP - Scripting Language	3	0	0	0	3	3	
5.	BCSE0255	Digital Marketing And Transformation	3	0	0	0	3	3	
PRACTICALS									
1.	BCSE0281	Full Stack Using Scripting Technologies Lab	0	0	2	0	1	2	
2.	BCSE0282	Full Stack Using Node JS Lab	0	0	2	0	1	2	
3.	BCSE0283	Full Stack Using C#.net Lab	0	0	2	0	1	2	
4.	BCSE0284	PHP - Scripting Language Lab	0	0	2	0	1	2	
PROJECTS									
1.	BCSE0291	Full Stack Using Scripting Technologies Project	0	0	0	0	2	-	
2.	BCSE0292	Full Stack Using Node JS Project	0	0	0	0	2	-	
3.	BCSE0293	Full Stack Using C#.net Project	0	0	0	0	2	-	
4.	BCSE0294	PHP - Scripting Language Project	0	0	0	0	2	-	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR /WK	PRE- REQUISITES
1.	BCSJ0950	Mini Project – I	0	0	0	0	2	0	
2.	BCSJ0951	Mini Project – II	0	0	0	0	2	0	
3.	BCSJ0971	Project – Part I	0	0	0	0	3	0	
4.	BCSJ0972	Project – Part II	0	0	0	0	8	0	
5.	BCSJ0991	Industrial Training	0	0	0	0	2	0	
		TOTAL	**0**	**0**	**0**	**0**	**17**	**0**	

Mandatory Non Graded Course

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
		THEORY							
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
5.	BCHM0202	Environmental Studies	2	0	0	0	2	2	
6.	BELM0001	Introduction to Bhagavad Gita	2	0	0	0	2	2	
		TOTAL	**8**	**0**	**0**	**0**	**0**	**8**	

Humanities and Social Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purposes – I	2	0	0	0	2	2	
4.	BELH0004	English for Professional Purposes – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAH0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	8	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	8	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG0001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BCSG0001	Python Programming	4	1	0	0	5	5	
5.	BCSC0001	Computer Programming	4	1	0	0	5	5	
PRACTICALS									
6.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
7.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
8.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
9.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
10.	BCSG0800	Python Programming Lab	0	0	2	0	1	2	
11	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	

Open Elective (Offer to other Departments)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
THEORY									
1.	BCSO0001	Data Structures and Applications	3	0	0	0	3	3	Programming
2.	BCSO0002	Introduction To Object Oriented Programming	3	0	0	0	3	3	Programming
3.	BCSO0003	Essentials of Information Technology	3	0	0	0	3	3	Object Oriented Programming
4.	BCSO0004	Elements of Soft Computing	3	0	0	0	3	3	
5.	BCSO0005	Fundamentals of Computer	2	0	0	0	2	2	
6.	BCSO0006	Introduction to Programming	2	0	0	0	2	2	
PRACTICALS									
7.	BCSO0070	Data Structures and Applications Lab	0	0	2	0	1	2	Programming
8.	BCSO0071	Introduction To Object Oriented Programming Lab	0	0	2	0	1	2	Programming
9.	BCSO0072	Essentials of Information Technology Lab	0	0	2	0	1	2	Object Oriented Programming
10.	BCSO0073	Elements of Soft Computing Lab	0	0	2	0	1	2	
11.	BCSO0074	Fundamentals of Computer Lab	0	0	2	0	1	2	
12.	BCSO0075	Programming Lab	0	0	2	0	1	2	

BCSG0001: PYTHON PROGRAMMING

Objective: *This course introduces the solving of mathematical problems using Python programming using OO concepts and its connectivity with database.*

Credits:05 **L-T-P-J:4-1-0-0**

Module No.	Content	Teaching Hours
I	Introduction to Python: Introduction and Basics; Setting up path Python Data Variables & Operators: Data Variables and its types, id () and type () functions, Coding Standards; **Control Structures:** if-else, elif, Nested if, Iteration Control structures, Break, Continue & Pass; **String Manipulation:** Accessing Strings, Basic Operations, String slices Function and Methods. **Lists:** Introduction, accessing list, Operations, Working with lists, Function and Methods. **Tuple:** Introduction, accessing tuples, Operations, Working, Functions and Methods. **Dictionaries:** Introduction, accessing values in dictionaries, Working with dictionaries, Properties, Functions.	22
II	**Functions:** Defining & Calling a function, Passing arguments to functions – Mutable & Immutable Data Types, Different types of arguments, Recursion, Scope of variables; **Modules and Packages:** User-defined modules and Standard Library: random, numpy, scipy, sys, Math Module, String Module, List Module, Date & Time Module, Regular Expressions: match, search, replace; **Input-Output:** Printing on screen, reading data from keyboard, Opening and closing file, Reading and writing files, Functions. **Exception Handling:** Exception, Exception Handling, except clause, try? finally clause, User Defined Exceptions. Basics of Python for Data Analysis, Introduction to series and data frames& Python using Pandas.	22

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focus on Employability under CO1, CO2,CO3,CO5,CO7.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of Python Programming.
- CO2: Apply the concepts of control structures and string manipulations of python programming.
- CO3: Understand the use of data structures available in PythonList, Tuple and Dictionary.
- CO4: Experiment user-defined functions and access built-in functions.
- CO5: Experiment user-defined modules and access built-in modules- math, random, string, date, time, datetime.
- CO6: Develop the programs using the concept of File Handling.
- CO7: Develop programs based on Exceptional Handling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO4
CO2	PO4/PSO1
CO3	PO5/PSO4
CO4	PO5,PO7/PSO1
CO5	PO2,PO8/PSO4
CO6	PO3,PO10/PSO2
CO7	PO5,PO9/PSO1

BCSC0001: COMPUTER PROGRAMMING

Objective: *To impart adequate knowledge on the need of problem solving techniques and develop programming skills to implements applications using the concepts of C Language. Also by learning the programming constructs they can easily switch over to any other language in future.*

Credits:05 **L-T-P-J:4-1-0-0**

Module No.	Content	Teaching Hours
I	**Generation of Programming Languages:** Low, Assembly, High and 4GL. **Language Processors:** Compiler, Interpreter, Assembler, Linker and Loader. **Algorithm:** Introduction, Features, Different Ways of stating Algorithms. **Flow Chart:** Introduction, Standard, Guidelines, Advantages and Limitations of using Flowcharts. **Basics of C:** Overview, Structure of a C program, Identifier, Keywords, Variables, Data types, Formatted Input and output. **Operators and Expression:** Assignment, Unary, Arithmetic, Relational, Logical, Bitwise, Conditional, Special operators and their precedence & Associativity. IEEE representation of data types like float & double, Lvalue and Rvalue **Type Conversion:** Type Promotion in expression, Conversion by Assignment, Truncation and Casting Arithmetic expression. **Decision and Case Control Structure:** if, if-else, nested if-else, Decisions using switch, switch versus if-else ladder, goto. **Loop Control Structure:** For loop, while loop, do-while loop, nesting of loops, break, and continue. **Arrays:** Introduction, one-dimensional and two-dimensional Array-Declaration, Initialization, Address Calculation. **Operations on Arrays:** Insertion, Deletion, Linear Search & Bubble Sort. **String:** Introduction, One dimensional and two dimensional Array-Declarations, Initialization **Operations on String:** Length, Copy, Reverse, Concatenate, Compare with & without built-in functions.	25
II	**Functions:** Declaration and Definition, Category of Functions, Parameter Passing Techniques – Call by Value, Passing Arrays to Functions. **Introduction to Storage Classes:** Auto, Static, Extern and Register. **Recursion:** Mechanics of Recursive Call, Implementation of Recursion, Recursion vs. Iteration. **The C Preprocessor:** Introduction, Macro Expansion and File Inclusion, Conditional Compilation and Miscellaneous Directives. **Pointers:** Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Arrays and Pointers, Pointer and Strings, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointer to an Array, Two Dimensional Array and Pointers, Pointers to Functions, Dynamic Memory Allocation, void Pointer and Null Pointer. **User Defined Types:**enum, typedef, Union and Structure - Declaration, Initialization, Nested Structures, Arrays of Structures, Structure and Pointer, Passing Structure Through Function. Difference between Structures and Union. **File Handling:** Data and Information, File Concepts, File Organization, File Operations: Open, Read, and Close, Trouble in Opening a File. File Opening Modes, Working with Text Files. Random Access to Files of Records. Introduction to Command Line Arguments.	25

Text Books:

- Behrouz A. Forouzan and Richard F. Gilberg, “Computer Science – A Structured Programming Approach Using C”, C Language Learning, 2007

Reference Books:

- Herbert Schildt, "C: The Complete Reference", 5th Edition, McGraw Hill Education
- K. N. King, "C Programming a Modern Approach", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, "The C Programming Language", PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO2,CO3,CO7.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of problem solving skills.
- CO2: Apply the basic principles of programming in C language.
- CO3: Understand the concepts of arrays and strings in C language.
- CO4: Apply the concepts of functions to solve real world problems.
- CO5: Illustrate the concepts of recursion.
- CO6: Understand the concepts of pointers in C language.
- CO7: Understand the basic concepts of file handling.
- CO8: Develop algorithmic solutions to simple computational problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO10/PSO1,PSO3
CO3	PO1,PO2,PO3,PO4/PSO1,PSO3
CO4	PO1,PO3, PO12/PSO1,PSO2
CO5	PO1,PO2,PO4 /PSO1,PSO3
CO6	PO1,PO2,PO3,PO4/PSO1,PSO2
CO7	PO1,PO3,PO6 /PSO1
CO8	PO1,PO2,PO4,PO10,PO12/PSO1,PSO3

BCSC0002: OBJECT ORIENTED PROGRAMMING

OBJECTIVE: *This course introduces the Object-Oriented programming paradigm to students. It also teaches a student how to think objectively and model a Java program for solving real-world problems.*

CREDITS: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Object-Oriented Programming:** Features of Object-Oriented Programming, Introduction to Object-Oriented Java Programming. **g Java Technology & Environment:** Understanding the compilation process of the JVM, JVM vs JDK vs JRE, Key Features of Java, Structure of a simple Java program. **Working with Java Primitive Data Types:** Strongly Typed nature of Java, Primitive Data Types in Java, The new 'var' keyword, Scope of a variable. **Accepting User Input in Java Programs:** using the Scanner class, using command line arguments. **Programming Constructs:** Sequence, Selection, Iteration & Transfer Statements, For-Each Loop. **Working with Java Arrays**: Declaring and Initializing One-Dimensional and Two-Dimensional Arrays in Java, Introduction to java. util. Arrays class. **The String API:** String Data Type, commonly used methods from the String API, StringTokenizer, StringBuilder & StringBuffer. **Creating and Using Methods:** Signature of a method, Types of Methods, Overloading methods in a class, Static and Non-Static Methods. **Describing and Using Objects & Classes:** Declare the structure of a Java class, declaring members of a class (fields and methods), declaring and using Java Objects, lifecycle of an Object (creation, assignment, dereferencing and garbage collection), Constructors of a class, Overloading Constructors, Constructor chaining using 'this' and 'super' keyword. **Using Java Packages:** create and import Java packages and static imports, abstracting program logic to packages, creating executable main class, running the executable class inside a package. **Applying Encapsulation**: Using access modifiers with/in a class, principles of encapsulation. **Programming Abstractly Through Interfaces:** create and implement Interfaces for programs, private and default methods in Interfaces, declaring Abstract Classes, Constructors in Abstract Classes. Marker Interface, Functional Interfaces, Lambda Expressions in Java.	20
II	**Reusing Implementations using Inheritance:** Declaring Subclasses and Superclasses, extend Abstract Classes, implementing Interfaces, exploring polymorphic behaviour by overriding methods, Object Types vs Reference Types, differentiate overloading, overriding and hiding. **Exception Handling:** Exception Hierarchy, Need of Exception Handling, Checked Exceptions, Unchecked Exceptions and Errors, Try-Catch Blocks, Finally, Throw & Throws Keywords, creating and handling Custom Exceptions. **Threads in Java:** Life Cycle of a Thread, creating threads using Runnable and Thread, 'sleep ()', Thread Priorities. **Using Wrapper Classes:** Wrapper Classes in Java, Boxing-Unboxing-Auto Boxing-Auto Unboxing. **Generics & Collections:** Creating Generic classes, Generic Methods, Diamond Notation, Wildcards, Type Erasure, Collection Hierarchy, Base Interfaces, Lists, Sets and Maps. **The Stream API:** Introduction to the Stream API, using lambda expressions in Streams. **Regular Expressions:** Pattern and Matcher Class. **JDBC:** JDBC Drivers, Connecting to a MySQL Database, DriverManager, Connection Interface, Statement Interface, Result Set Interface, Prepared Statements.	18

Text Book:

- Herbert Schildt, "The Complete Reference, Java Eleventh Edition", Oracle Press.2019.

Reference Book:
- Cay S Hosrtmann, "Core Java Volume I—Fundamentals, Eleventh Edition", Pearson,2018.
- Rogers Cadenhead, "Sams Teach Yourself Java in 21 Days (Covers Java 11/12), 8th Edition", Pearson,2020.

Focus: This Course focuses on Employability under CO3 ,CO5,CO7,CO8.

Outcomes: After completion of the course, students will be able to -
- CO1: Understand the basics of Object-Oriented Programming paradigm.
- CO2: Construct the logical flow of programs by using the sequence ,selection ,iterations and transfer statements.
- CO3: Apply the concepts of Object-Oriented Programming to model programs in Classes, Abstract Classes, Interfaces and Enums, and simplify program function by dissecting it into methods.
- CO4: Understand accessibility of members in a program unit and create packages to prevent namespace collisions.
- CO5: Predict run-time errors in a program by examining program functioning.
- CO6: Show the parallel processing capabilities of a program using a multithreading concept.
- CO7: Experiment with the predefined classes and interfaces defined in the Collections Framework.
- CO8: Develop a program using JDBC connectivity to demonstrate data persistence.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1/PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/PSO2
CO7	PO1,PO2,PO11/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO2

BCSC0003: DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database& NoSQL system. Students learn how to design and create a good database.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	Introduction: An Overview of Database Management System, Database System Vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with Case Studies. Data Modeling Using the Entity-Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. Relational Data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization I:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, Non-Redundant Cover, Canonical Cover. PL/SQL: Query languages, nested queries, group by and having clause.	20
II	**Database Design & Normalization II:** 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, MVD and JDs, Inclusion Dependence. **File Organization:** Indexing, Structure of Index files and Types, Dense and Sparse Indexing **Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication.	20

Text Books:

- Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, Addison Wesley,2010.
- Sadalage, P. &Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education,2012.

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan, "Database Concepts", 5th Edition, TMH,1998.
- Redmond, E. & Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focus on Employability and Skill Development under CO1,CO2,CO6.

Outcome: After the completion of the course, the student will:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys,using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss indexing mechanisms for efficient retrieval of information from a database.

- CO8: Discuss recovery system and be familiar with introduction to web database, distributed databases.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1 /PSO1
CO2	PO2, PO3/ PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3,PO9/ PSO2
CO7	PO1,PO11 /PSO1
CO8	PO1,PO3,PO12/ PSO2

BCSC0004: OPERATING SYSTEMS

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Operating System and its Classification - Batch, Interactive, Multiprogramming, Time sharing, Real Time System, Multiprocessor Systems, Multithreaded Systems, System Protection, System Calls, Reentrant Kernels, Operating System Structure- Layered structure, Monolithic and Microkernel Systems, Operating System Components, Operating System Functions and Services. Processes: Process Concept, Process States, Process State Transition Diagram, Process Control Block (PCB), Process Scheduling Concepts, Threads and their management. Process Synchronization: Principle of Concurrency, Implementation of concurrency through fork/join and parbegin/parend, Inter Process Communication models, shared memory and message passing Schemes, Producer / Consumer Problem, Critical Section Problem, race condition ,two process software solution Dekker's solution, Peterson's solution, Semaphores, Synchronization Hardware.	20
II	Classical Problem in Concurrency: Dining Philosopher Problem, Readers Writers Problem, sleeping barbar, **Deadlock:** System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock, Combined Approach. **Memory Management:** Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation. **Virtual memory concepts:** Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Locality of reference. **I/O Management and Disk Scheduling:** I/O devices, I/O subsystems, I/O buffering, Disk storage and disk scheduling. **File System:** File concept, File organization and access mechanism, File directories, File allocation methods, Free space management.	20

Text Books:

- Silberschatz, Galvin and Gagne, "Operating Systems Concepts",9th Edition, Wiley, 2012.

Reference Books:

- SibsankarHalder and Alex a Aravind," Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel, "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere, "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach, "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability and Skill Development under CO1,CO2,CO5.

Outcomes: After completion of course, the student will be able to:

- CO1: Understand the classification of operating system environment.
- CO2: Understand the basic of process management.
- CO3: Apply the concept of CPU process scheduling for the given scenarios.
- CO4: Illustrate theprocess synchronization and concurrency process in operating system.
- CO5: Analyze the occurrence of deadlock in operating system.
- CO6: Describe and analyze the memory management and its allocation policies.

- CO7: Understand the concepts of disk scheduling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO4/PSO1,POS3
CO4	PO3,PO4,PO6/PSO3,PSO4
CO5	PO1,PO4/PSO1,PSO3
CO6	PO1,PO2/PSO1,PSO3
CO7	PO1,PO2,PO7/PSO1,PSO3

BCSC0005: COMPUTER ORGANIZATION

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**PREAMBLE:** Subject Introduction, Basic organization of the computer and block level description of the functional units, Number Representation, Fixed and floating-point Number Representation-Arithmetic Addition/subtraction, overflow, IEEE standard for floating point representation, Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description. Introduction to combinational circuit - Half Adder, Full Adder, carry look ahead adder, Multiplexor/ De multiplexer and Decoder/Encoder, Introduction to sequential circuit- Flip-Flops, Synchronous and Asynchronous Counters, Register, Bus and memory Transfer Language. **Arithmetic Operations:** Addition and subtraction of signed numbers, Hardware implementation of Method, Multiplication: Signed operand multiplication, Booths algorithm, Hardware implementation of Algorithms, Array Multiplier. **Processor Organization:** General register organization, Single Accumulator and Stack organization, Addressing Modes, Types of Computer Instructions – one, two, three & four address, Instruction Cycle, Instruction Formats	20
II	**Micro-operations:** Arithmetic, Logical & Shift Micro operations with some applications. **Multiprogramming and Multiprocessing:** Introduction to pipelined operation. **Hardwired & Microprogrammed Unit:** Execution of a complete instruction & Branch Instructions, Hardwired control Unit, Micro programmed control Unit, Micro-Instructions, Microinstruction with Next Address field, Pre-Fetching Microinstructions, Concept of Horizontal and Vertical Microprogramming. **Memory:** Basic concept and Hierarchy, RAM memories, 2D, 2 & 1/2D Memory Organization, ROM Memories, Cache Memories: Concept and Design issues performance, Address mapping and Replacement, Auxiliary memories: Magnetic disk, Magnetic tape and Optical disks, Virtual memory: Concept and Implementation. Input/Output: Peripheral Devices, I/O interface, I/O ports. **Interrupts:** Interrupt hardware, Types of Interrupts and Exceptions, Buses, Bus architecture, Types of Buses and Bus Arbitration. Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O, Direct Memory Access, I/O channels and Processors, Standard communication interfaces.	**20**

Text Books:

- M. Mano, "Computer System Architecture", 3rd Edition, PHI,1996

Reference Books:

- D.W. Patterson, "Computer Organization and Design", 4th **Edition**, Elsevier Publication, 2008.
- William Stalling, "Computer Organization",8th Edition, PHI, 2011.
- V. CarlHamacher, Zaky, "Computer Organization",4th International Edition, TMH, 1996.
- John P Hays, "Computer Organization", 2nd Edition, TMH.
- Tannenbaum , "Structured Computer Organization", 5thEdition, PHI, 2005.
- P Pal Chaudhry, "Computer Organization & Design", 2ndEdition, PHI, 2002.

Focus: This Course focuses on Employability under CO1,CO2,CO6

Outcomes: After completion of the course, the student will be able to:

- CO1: Understand the basics of digital computer system.
- CO2: Demonstrate the principle of arithmetic operations on unsigned, signed integers and floating point numbers.
- CO3: Understand the concepts of Combinational and Sequential circuits and their applications.
- CO4: Understand the CPU architecture and organization.
- CO5: Explain the basic concepts of pipelining.
- CO6: Design the steps for the execution of the complete instruction for hardwired and micro-programmed control unit.
- CO7: Explain the function of memory hierarchy.
- CO8: Determine the interface of CPU with input/output devices and their modes of transfer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO1,PO3/PSO1
CO3	PO2,PO3,PO5/PSO2
CO4	PO2,PO3,PO4/PSO1,PSO3
CO5	PO2,PO3,PO4/PSO2
CO6	PO1,PO2,PO3/PSO1,PSO3
CO7	PO2,PO3,PO5/PSO2,PSO3
CO8	PO3,PO4/PSO1

BCSC0006: DATA STRUCTURES AND ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs*.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Terminology, Elementary Data Organization, Properties of an Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic Notations – Big-Oh; Operations on Data Structure, Abstract Data Types (ADT). **Linked Lists:** Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Generalized Linked List, Polynomial Representation and Addition. **Stacks:** Primitive Stack Operations - Push & Pop, Array and Linked Implementation of Stack in C, Application of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of Infix to Postfix expression, Recursion, Principles of Recursion, Tail Recursion, Removal of Recursion, use of stack in Recursion, Tower of Hanoi Problem. **Queues:** Operations on Queue - Add, Delete operations, Implementation of Queue Using Array and Linked List, Circular Queues, Deque and Priority Queue. **Trees:** Basic Terminology, Array Representation and Dynamic Representation; Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Tree Traversal Algorithms - Inorder, Preorder and Postorder; Threaded Binary Trees, Traversing Threaded Binary Trees.	20
II	**Search Trees:** Binary Search Trees (BST), Insertion and Deletion in BST, AVL Trees, Introduction to M-Way Search Trees, B Trees. Threaded binary trees, Priority Queues –Definition and applications, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, and Deletion from a Max Heap. Searching: Sequential Search, Binary Search. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Two Way Merge Sort, and Heap Sort. **Graphs:** Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees – Prim's and Kruskal's Algorithm; Shortest Path Algorithm – Bellman-Ford and Dijkstra's Algorithm. **Hashing & Indexing:** Hash Function, Collision Resolution	20

Text Book:

- Aaron M. Tanenbaum, YedidyahLangsam and Moshe J. Augenstein, "Data Structures Using C and C++", 2nd Edition, PHI, 2009.

Reference Books:

- Horowitz and Sahani, "Fundamentals of Data Structures", 3rd Edition, W H Freeman & Co, 2004-05.
- Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with Applications", 2nd Edition, TMH, 2007.
- R. Kruse, "Data Structures and Program Design in C", 2nd Edition, Pearson Education, 2004.
- LipschutzSchaum's Outline Series, "Data Structures", 12th Reprint, TMH, 2010.
- G A V Pai, "Data Structures and Algorithms", TMH, 2009.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.
Outcomes: After completion of course, student will be able to:

- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2
CO3	PO1/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4/PSO3
CO6	PO2/PSO4
CO7	PO2/PSO4

BCSC0007: INTRODUCTION TO MICROPROCESSORS

Objective: *Objective of this subject is to introduce the basic concepts of microprocessor and assembly language programming. Identify and explain the operation of the components of typical microprocessor: the role of the ALU, registers, stack and the use of interrupts.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Microprocessors Evolution and Types, Basics of Pentium Microprocessor, Microprocessor Application, **8-Bit Microprocessor:**8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction Set - Data Transfer Operation, Arithmetic Operation, Logic Operations and Branch Operations; Introduction to Assembly Language Program. **Programming Technique with Additional Instruction**: Looping, Counting, Indexing, Additional Data Transfer and 16-Bit Arithmetic Instruction, Counters and Time Delays, Stack and Subroutine.	20
II	**16 Bit Microprocessor:** Architecture of 8086 – Register Organization, Execution Unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities. **Peripheral Interfacing:** I/O Programming, Programmed I/O, Interrupt Driven I/O, DMA I/O, Memory-Mapped I/Os. **Peripheral Devices:** 8237 DMA Controller, 8255 Programmable Peripheral Interface, 8253/8254 Programmable Timer/Counter, 8259 Programmable Interrupt Controller.	18

Text Books:

- N Senthil Kumar, MSaravanan, and S Jeevananthan, "Microprocessors and Microcontrollers", Oxford University Press India, 2010.

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- Ray A.K. Bhurchandi.K.M, "Advanced Microprocessor and Peripherals", TMH, 2002.
- D. V. Hall, "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.
- Y.C. Liu and G.A. Gibson, "Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design", 2nd Edition, PHI, 2003.

Focus: This Course focuses on Employability under CO1, CO2,CO6

Outcomes: After the completion of the course, the student will be able to:

- CO1: Demonstrate the Microprocessor internal architecture and its operations.
- CO2: Develop programs based on 8085 microprocessor instruction set and addressing mode.
- CO3: Develop program using looping, counting, indexing, counter and time delays.
- CO4: Understand the concept of stack and subroutine for modular approach.
- CO5: Compare accepted standards and guidelines to select microprocessor (8085 & 8086) to meet performance requirements.
- CO6: Analyze the concept of interfacing the processor to external device with I/O programming & Interrupt Driven I/O.
- CO7: Understand the working of interfacing chips (8237, 8253/54, 8255 & 8259).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1,PSO2
CO3	PO2,PO3/PSO1,PSO2
CO4	PO1,PO2,PO3/PSO1,PSO3
CO5	PO2,PO3,PO5/PSO1,PSO3
CO6	PO1,PO2/PSO3
CO7	PO1,PO2,PO4/PSO3

BCSC 0008: Computer Networks

Objective: *The objective is to understand fundamental underlying principles of computer networking, details and functionality of layered network architecture.*

Credits: 03 **Semester - IV** **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	Network Software: Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Services, Service Primitives, The Relationship of Services to Protocols. Reference Models: The OSI Reference Model, The TCP/IP Reference Model. Example Networks: The Internet, Connection-Oriented Networks (X.25, Frame Relay & ATM), Ethernet. **Introduction Concepts**: Goals and Applications of Networks, Network structure and architecture, Network Topology Design, Physical Layer Transmission Media, Line coding scheme, switching methods (circuit switching, Packet switching), TDM. **Medium Access sub layer**: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols, CSMA, CSMA/CD, Overview of IEEE standards.	20
II	**Data Link Layer**: Error detection and correction, Flow control (sliding window protocol) **Network Layer**: Network Layer –IP addressing, subnet, CIDR, VLSM, Internetworking, Address mapping, routing. Connecting devices. **Transport Layer**: Transport Layer - Design issues, connection management, Flow control, TCP window management, congestion control-slow start algorithm. **Application Layer**: Data compression, Data Encryption, File Transfer, DNS, HTTP, SMTP, TELNET **Introduction to IPv6, transition from IPv4 to IPv6.**	20

Text Books:

- Forouzan B. A. , "Data Communication and Networking", 4th Edition, McGrawHill,2004.

References:

- Kurose, J.F. and Ross K.W., "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Addison-Wesley,2005.
- A.S. Tanenbaum, "Computer Networks", 2nd Edition, Prentice Hall India,2006.

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO5,CO8.

Outcomes: After the completion of the course, the student will be able to:

- CO1: Understand the concept of OSI and TCP/IP reference model.
- CO2: Understand the basics of data transmission at physical layer.
- CO3: Understand the channel allocation using ALOHA, CSMA and CSMA/CD.
- CO4: Apply error detection and correction technique to eliminate transmission error.
- CO5: Analyze the fixed and variable length address (IPv4) subneting for the given scenarios.
- CO6: Understand the design issues of the transport layer.
- CO7: Understand the mechanism of protocols at application layer such as FTP, HTTP, Telnet, DNS.
- CO8: Understand IPv6 addressing and differentiate it from IPv4.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO12/PSO1
CO2	PO1/PSO2
CO3	PO1,PO4/PSO1,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO4,PO6/PSO3
CO6	PO2,PO4/PSO1
CO7	PO5,PO12/PSO2
CO8	PO4,PO7/PSO4

BCSC0009: SOFTWARE ENGINEERING

Objective: *Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility.*

L–T–P-J: 3–0–0-0

Credits: 03

Module No.	Content	Teaching Hours
I	**Introductory Concepts**: The evolving role of software – characteristics, components and applications. A Generic view of process: Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. Process Models: Waterfall Model, Prototyping, Incremental, Spiral. Agile software Development: Introduction to Agile, Agile software development framework. **Software Requirement Specification**: Requirement Process, SRS Components, Requirement Specifications with Use Cases Diagram. **Software Project Planning:** Project Planning Objectives. **Software Metrics:** Size, Function Point, Staffing, Project Estimation Methods– COCOMO Model. **Function-Oriented Design**: Problem Partitioning, Abstraction, Top Down and Bottom Up Design. **Module-Level Concepts:** Coupling, Cohesion, Design Notation and Specification - Structure Charts; Structured Design Methodology - Data Flow Diagram, Sequence Diagram.	20
II	**OO Analysis and OO Design:** OO Concepts, Introduction to UML Design Patterns: Class Diagram, Activity Diagram, State Chart Diagram. **Coding**: Coding Process, Verification – Code Inspections, Software Metrics. **Testing Fundamentals**: Test Case Design, Black Box Testing Strategies, White Box Testing, Unit Testing, Integration Testing, System Testing. **Introduction to Automation Testing and Testing Tools:** Automated Testing Process, Framework for Automation Testing, Introduction to Automation Testing Tool. **Software Quality:** Models, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model. **Software Maintenance**: Models Cost of Maintenance, Re-engineering, Reverse Engineering.	18

Text Books:

- R. S. Pressman , "Software Engineering: A Practitioners Approach", 7thEdition, McGraw Hill,2010.

Reference Books:

- K. K. Aggarwal and Yogesh Singh , "Software Engineering", 3rd Edition, New Age International Publishers,2008.
- Rajib Mall , "Fundamentals of Software Engineering", 3rd Edition, PHI Publication,2009.
- R.E Fairley , "Software Engineering", McGraw Hill,2004.
- Sommerville, "Software Engineering", 9th Edition, Pearson Education,2010.

Focus: This Course focuses on Employability and Skill Development/Entrepreneurship under CO1,CO2,CO6.

Outcomes: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of software engineering.
- CO2: Apply software processes to solve real world problems.
- CO3: Estimate the cost, effort and schedule of software using COCOMO Model.

- CO4: Analyze the software design techniques (structure chart, SDM, sequence diagram).
- CO5: Understand the basic concepts of OO analysis and design.
- CO6: Develop the test cases to validate the software.
- CO7: Understand the basic models of software Quality and maintenance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7/PSO1
CO2	PO2,PO3/PSO4
CO3	PO2,PO11/PSO3
CO4	PO3,PO10/PSO4
CO5	PO3,PO7/PSO1
CO6	PO5,PO12/PSO2
CO7	PO4,PO9,PO12/PSO1

BCSC0010: DISCRETE MATHEMATICS

Objective: *The objective is to introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in computer science.*

Credits: 4 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Sets, Relations and Functions:** Introduction to Set Theory, Venn diagrams, algebra of Sets, Inclusion-Exclusion Principle, Partitions, Proof Techniques, Relations, Properties and their types, Function and their types. Recurrence Relations and Generating Functions **Introduction to Counting Principle**: Permutation, Combination, Permutation with Repetition, Combination with Repetition, Pigeonhole Principle. **Probability Theory**: Introduction to Probability Theory, Conditional Probability, Total Probability, Bayes' Theorem.	20
II	**Propositional Logic -** Logical Connectives, Truth Tables, Normal Forms (Conjunctive and Disjunctive), Validity; **Predicate Logic -** Quantifiers, Inference Theory, Methods of Proof: Direct, Indirect, Mathematical Induction. **Algebra**: Motivation of Algebraic Structures, Finite Groups, Subgroups and Group Homomorphism; Lagrange's Theorem; Commutative Rings and Elementary Properties; **Graph Theory:** Introduction to Graphs, Types: Planner, Directed, Complete, Bipartite Graph, Isomorphism , Euler Graph, Hamiltonian Graph, Operations on Graphs, Representation of graphs, Connectivity.	20

Text Book:

- Kenneth H Rosen , "Discrete Mathematics and Its Applications", 7th edition, TMH,2012.

Reference Books:

- J.P. Tremblay , "Discrete Mathematical Structures with Applications to Computer Science", TMH, New Delhi,1997.
- V. Krishnamurthy , "Combinatorics: Theory and Applications", East-West Press, New Delhi,1986.
- Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics- An Applied Introduction", 5th Edition, Pearson Education,2004.
- C.L. Liu, "Elements of Discrete Mathematics", 2nd Edition, TMH,2000.

Focus: This Course focuses on Employability and Skill Development under CO1,CO2,CO3,CO7,CO8

Outcomes: After the completion of the course, the student will be able to:

- CO1: Understand the notion of mathematical thinking and proofs to solve the problem.
- CO2: Apply the basics of discrete probability and number theory to solve the real world problem.
  CO3: Analyze basic discrete structures and algorithms using effectively algebraic techniques.
- CO4: Analyze mathematical concepts like sets, reasoning, relational algebra and graph theory to solve optimization problems.
- CO5. Analyze the validity of an argument using logical notation.
- CO6. Demonstrate the basic structures of proof techniques to write and evaluate the validity of arguments.
- CO7. Understand the basic principles of sets,set equalities and operations in sets.
- CO8. Apply counting principles to determine probabilities.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO3
CO2	PO1,PO3/PSO4
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3
CO5	PO1,PO2/ PSO3
CO6	PO1,PO3/PSO2,PSO3
CO7	PO1,PO2/PSO1
CO8	PO1,PO3/PSO1,PSO4

BCSC0011: THEORY OF AUTOMATA & FORMALLANGUAGES

Objective: *The objective of this course is that students will study and compare different models and views of the abstract notion of computation and its various aspects.*

Credits:04 **Semester V** **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem; FA with Output - Moore and Mealy machine, Applications and Limitations of FA. **Regular expression (RE):** Regular Expression to FA, DFA to Regular Expression, Arden Theorem, Non Regular Languages, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages. **Push Down Automata (PDA):** Introduction, Language of PDA, Acceptance by Final State, Acceptance by Empty Stack, Deterministic PDA.	20
II	**Context Free Grammar (CFG) and Context Free Languages (CFL):** Introduction, Derivation Trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Simplification of CFGs, Normal Forms for CFGs - CNF and GNF; Pumping lemma for CFLs, Equivalence of PDA and CFG. **Turing machines (TM):** Basic Model, Definition and Representation, Variants of Turing Machine and their equivalence, TM for Computing Integer Functions, Universal TM, Church's Thesis, Recursive and Recursively Enumerable Languages, Halting Problem, Introduction to Computational Complexity. Decidability: Post's Correspondence Problem (PCP), Rice's Theorem, Decidability of Membership, Emptiness and Equivalence Problems of Languages.	20

Text Books:

- K.L.P. Mishra and N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI,2006

Reference Books:

- Hopcroft, Ullman , "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education,2013.
- Martin J. C ," Introduction to Languages and Theory of Computations", 4th Edition, TMH,2011.

Focus: This Course focuses on Employability under CO1, CO2,CO3,CO5.

Outcomes: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of Context Free languages, Expression and Grammars.
- CO2: Analyze the conversion of NFA to DFA, Mealy to Moore and Moore to Mealy.
- CO3: Analyze the process to convert regular expression to DFA, DFA to regular expression, and minimization of DFA.
- CO4: Develop the PDA for the context free language and context free grammar.
- CO5: Analyze that the grammar is ambiguous or unambiguous.
- CO6: Apply the process to convert CFG to CNF and GNF.
- CO7: Understand the concept of Turing machine and its variants.
- CO8: Design the Turing machine for the real world application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO4
CO2	PO2,PO3/PSO3
CO3	PO2,PO3,PO9,PO12/PSO1,PSO3,PSO4
CO4	PO1,PO3,PO5,PO9/PSO3,PSO4
CO5	PO1,PO2,PO4/PSO3
CO6	PO2,PO3/PSO3
CO7	PO1,PO2/PSO1,PSO3
CO8	PO3,PO12/PSO1,PSO2,PSO3

BCSC0012: DESIGN & ANALYSIS OF ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and concepts including Trees, Recursion & Dynamic programing.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Algorithms, analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Sorting and order Statistics - Shell sort, Quick sort, Merge sort, Heap sort, Comparison of sorting algorithms, Sorting in linear time. **Advanced Data Structures:** Red-Black trees, B – trees, Binomial Heaps, Fibonacci Heaps. Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching.	20
II	Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets Dynamic programming with examples such as Knapsack. All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem	20

Text Books:

- Thomas H. Coremen, Charles E. Leiserson and Ronald L. Rivest, Introduction to Algorithms, Third edition, Prentice Hall of India,2008.

Reference Books:

- Gilles Brassard Paul Bratley," Fundamentals of Algorithms", Prentice Hall,1996.
- Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd,2008.
- Levitin , "An Introduction to Design and Analysis of Algorithms", Pearson,2008.

Focus: This Course focuses on Employability under CO1,CO2,CO6.

Outcomes: After completion of course, student will be able to:

- CO1: Understanding of complexity representation in terms of Big Oh, Theta and Omega notations.
- CO2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms (quick sort and merge sort).
- CO3: Compare and analyze different data structures (RB Tree, B Tree, Binomial Heaps, Fibonacci Heaps).
- CO4: Understand the major graph algorithms (DFS, BFS, Dijkstra's Bellman Ford) and their analyses.
- CO5: Understand the greedy paradigm and able to analyze when an algorithmic design situation calls for it. Synthesize greedy algorithms (Optimal Reliability Allocation, Minimum Spanning Trees, factorial Knapsack) and analyze them.
- CO6: Synthesize dynamic-programming algorithms (0/1 knapsack problem, Resource allocation problem, Warshal's and Floyd's algorithms) and analyze them.
- CO7: Understand the backtracking paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize backtracking algorithms (N Queen Problem, TSP Problem, sum of subsets problem, Graph Coloring) and analyze them.

- CO8: Understand the branch and bound paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize branch and bound algorithms (N Queen Problem, TSP Problem, Hamiltonian Cycles, Graph Coloring) and analyze them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4,PO12/PSO1,PSO3
CO2	PO1,PO3,PO4,PO5/PSO1,PSO3
CO3	PO1,PO3,PO6/PSO1,PSO3
CO4	PO1,PO2,PO3,/PSO1,PSO3
CO5	PO1,PO2/PSO1,PSO3
CO6	PO1,PO2,PO3, PO6/PSO1,PSO3
CO7	PO1,,PO4,PO12/PSO1,PSO3
CO8	PO1,PO2,PO3,PO4,PO12/PSO1,PSO2

BCSC0014: APPLIED DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database& NoSQL system. Students learn how to design and create a good database.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with case studies. **Data Modeling Using the Entity-Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. **Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, Non Redundant Cover, Canonical Cover, MVD and JDs, Inclusion Dependence.	26
II	**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication. **NoSQL System:** RDBMS vs NoSQL, BASE properties, Key-value, Columnar, Document and Graph-Based database, Introduction of MongoDB, Cassandra, Neo4j and Riak. **Database Programming using Python**: Database connectivity, Retrieving Data from Database, Parameters Passing, Execute many Methods, Cursor Attributes, Invoke Stored Procedures, Invoke Stored Functions.	26

Text Books:

- Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan, "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. &Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1, CO2,CO6.

Outcomes: After completion of course, student will be able to:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss recovery system and be familiar with introduction to web database, distributed databases.
- CO8: Explain the differences between RDBMS and No-SQL,BASE properties and No-SQL databases.
- CO9:Design and implement the database system with the fundamental concepts of DBMS using Python.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2,PO3/PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3/PSO2
CO7	PO1,PO3/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO4
CO9	PO1,PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0015: APPLIED DATA STRUCTURES AND ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs.*

CREDITS: 05 **L-T-P-J: 4-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Basic Terminologies, Elementary Data Organization with Arrays. **Algorithm**: Definition, Characteristics of an Algorithm, Time and Space Complexity. **Introduction to Asymptotic Notations**: Big-Oh, Big-Omega, Big-Theta **Operations on Data Structures**: Insertion, Deletion, Searching, Sorting, Traversing and Merging. **Abstract Data Types (ADT)**. **Linked Lists**: Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Polynomial Representation and Addition. **Stacks**: Primitive Stack Operations - Push & Pop, Array and Linked List Implementation of Stack, Applications of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of Infix to Postfix expression. **Recursion**: Principles of Recursion, Head & Tail Recursion, Removal of Recursion, Use of stack in Recursion, Tower of Hanoi Problem, Nth Term of a Fibonacci Series. **Queues**: Operations on Queue – Enqueue & Dequeue operations, Implementation of Queue using Array and Linked List, Circular Queues, DEQueue. **Trees**: Basic Terminology, Array Representation and Linked Representation; Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Tree Traversal Algorithms - Inorder, Preorder and Postorder; **Search Trees**: Binary search trees, search efficiency, insertion and deletion operations, importance of balancing, AVL trees, searching, insertion and deletions in AVL trees, Tries, Red-Black Trees.	20
II	**Heaps**: Heaps as priority queues, heap implementation, insertion and deletion operations, binary heaps, binomial and Fibonacci heaps, heapsort, heaps in Huffman coding. **Hashing**: Search efficiency in lists and skip lists, hashing as a search structure, hash table, collision resolution. **Searching**: Sequential Search, Binary Search. **Sorting**: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Radix Sort, Bucket Sort. **Graphs**: Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees – Prim's and Kruskal's Algorithm; Shortest Path Algorithm – Bellman-Ford and Dijkstra's Algorithm. **Basic Algorithmic Techniques**: Greedy Algorithms, Divide & Conquer, Dynamic Programming. Backtracking. **Collections Framework:** Implementation of Collections Framework as Data Structures (Queue, Stack, List, Map, Set, Deque, PriorityQueue, Vector, Hashtable)	20

Text Books:

- Robert Lafore, "Data Structures And Algorithms in Java", 2nd Edition, Pearson SAMS,2003.

References Books:

- Elliot B. Koffman, Paul A. T. Wolfgang , "Data Structures: Abstraction and Design Using Java", 3rd Edition, Wiley,2016.
- Michael T. Goodrich, RobertoTamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Java", 6th Edition, Wiley,2014.
- Horowitz and Sahani, "Fundamentals of Data Structures", 3rd Edition, W H Freeman & Co,2004-05.

Focus: This Course focuses on Employability under CO1,CO2,CO6,CO7.

Outcomes: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.
- CO8: Understand the concepts of greedy approach, divide & conquer and dynamic programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO3
CO2	PO1,PO2,PO4/PSO3
CO3	PO1,PO2,PO3/PSO1,PSO4
CO4	PO1,PO2,PO3/PSO1,PSO2,PSO4
CO5	PO1,PO2,PO3,PO4,PO5/PSO1,PSO4
CO6	PO2,PO3/PSO1,PSO2
CO7	PO3,PO6,PO12/PSO1,PSO2
CO8	PO2,PO4/PSO3,PSO4

BCSG0800: PYTHON PROGRAMMING LAB

Objective: *This course introduces the solving of problems using Python programming using OO concepts and its connectivity with database.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours

I & II	Programs based on the concepts of: • Building Python Modules • Obtaining user Data • Printing desired output Programs based on the concepts of: • Conditional if statements • Nested if statements • Using else if and elif Programs based on the concepts of Iteration using different kinds of loops Usage of Data Structures • Strings • Lists • Tuples • Sets • Dictionary Program based on the concepts of User-defined modules and Standard Library (random, numpy, scipy, sys, Math Module, String Module, List Module). Program based on Input Output. Program based on exception Handling. Program based on Simple Data analysis. Program based on Pandas.	26

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcomes: By the end of the course, students will learn to:

- CO1: Apply OO concepts using Python programming.
- CO2: Apply in-built packages defined in Python.
- CO3: Apply front-end as Python Programming to connect with any back-end.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO4
CO3	PO5/PSO2

BCSC0800: COMPUTER PROGRAMMING LAB

Objective: *The objective is to provide a comprehensive study of the C programming language. It stress the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	• Mapping of flow chart, Algorithm, Language • Simple C-program execution • Programs based on various operators • Programs based on Decision and case Control Structure • Programs based on Loop Control Structure • Program based on special control statement ➢ break ➢ continue • Programs based on Array Insertion, Deletion, Linear Search & Bubble Sort • Programs based on String ➢ Length, Copy, Reverse, Concatenate, Compare with & without built-in functions • Programs based on Functions. • Programs based on Storage Class. • Programs based on Recursion. • Programs based on Preprocessor. • Programs based on Pointers • Programs based on array • Programs based on string • Programs based on call by value and call by reference • Programs based on Dynamic Memory Allocation • Programs based on User Defined Data types ➢ Structure and Union ➢ Enum and Typedef • Programs based on File handling ➢ Opening a file ➢ Reading, writing and appending a file ➢ Closing file ➢ Random Access to Files of Records • Programs based on Command Line Argument.	52

Reference Books:

- Herbert Schildt, "C: The Complete Reference", 5th Edition, McGraw Hill Education
- K. N. King, "C Programming a Modern Approach", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, "The C Programming Language", PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: On Completion of this course, students are able to:

- CO1: Design programs involving decision structures, loops and functions.
- CO2: Understand the concepts of functions, recursion, pointers and file handling.
- CO3: Design programs involving structures, union and functions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO3,PO4/PSO1
CO3	PO3/PSO2,PSO4

BCSC0801: OBJECT ORIENTED PROGRAMMING LAB

Objective: *The objective of this course is that students will study and learn Object Oriented Modeling and programming.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I& II	Programs in Java and python based on the concepts of: • Classes, Constructors, Polymorphism and Keyword Static. Programs based on the concepts of: • Inheritance, Multithreading Using Thread Class & Interface Runnable, String Handling, Generic Classes. Programs based on the concepts of: • Handling Database Connectivity. • Implementation of Collection Framework. Programs based on the concepts of: • Database Connectivity. • Retrieving Data from Database. • Parameters Passing, Execute many Method. • Cursor Attributes. • Invoke Stored Procedures. • Invoke Stored Functions.	24

Reference Books:

- Naughton, Schildt, “The Complete Reference JAVA2”, 9th Edition, Oracle Press.
- Bhave&Patekar, “Programming with Java”, Pearson Education
- Bret Slatkin: “Effective Python: 59 Specific ways to write better Python”, Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: After completion of course, the student will be able to:

- CO1: Implement object oriented language features.
- CO2: Design GUIs and Graphical programming.
- CO3: Design object oriented solutions for small systems involving database and event handling concepts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO5/PSO2
CO3	PO3,PO5/PSO4

BCSC0802: DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Generation of database report,.	24

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan, "Database Concepts", 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, "Database Management System", TMH

Focus: This Course focuses on Employability under CO1,CO2,CO4 &3.

Outcomes: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Develop the SQL queries for real life scenarios.
- CO3: Implement the procedural language (PL/SQL) and Triggers.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO1,PO2/PSO1,PSO4
CO3	PO2,PO3,PO5/PSO2,PSO3

BCSC0803: OPERATING SYSTEMS LAB

Objective: *The lab aims to develop understanding the operation of UNIX operating system.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implement the following basic commands (with options) used in UNIX/LINUX OS. • Write and implement the basic vi editor commands. • Shell scripts that use simple commands. • Decision based Shell scripts. • Shell scripts related to strings. • Shell scripts using pipes. • Shell scripts with loop statements. • Demonstration and solution for race condition. • Demonstration and use of System Calls. • Implement the basics of IPC in UNIX. • Implementation of Classical Problem in Concurrency	24

Reference Books:

- SibsankarHalder and Alex a Aravind,” Operating Systems”, 6th Edition, Pearson Education, 2009.
- Harvey M Dietel, “An Introduction to Operating System”, 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere, “Operating Systems: A Concept Based Approach”, 2nd Edition, 2006.
- M. J. Bach. , “Design of the Unix Operating System”, PHI, 1986.

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: After completion of course, the student will be able to:

- CO1: Implement the basic operations on UNIX operating systems.
- CO2: Demonstrate the working of systems calls.
- CO3: Demonstrate message passing in Unix operating system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO4,PO5/PSO1,PSO2

BCSC0804: COMPUTER ORGANIZATION LAB

Objective: *The aim of the lab is to better understand the design of sequential Circuits such as Flip-Flops, Registers, and Counters.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• Bread Board Implementation of Flip-Flops. • Experiments with clocked Flip-Flops. • Design of Counters. • Bread Board implementation of Counters &Shift Registers. • Implementation of Arithmetic Algorithms. • Bread Board implementation of Adder/Subtraction (Half, Full). • Bread Board implementation of Binary Adder. • Bread Board implementation of Seven Segment Display. • Small Project based on combinational and sequential circuit. • Verify the excitation tables of various FLIP-FLOPS . • Design of an 8-bit ARITHMETIC LOGIC UNIT. • Design of 24x8 (16 byte) RAM. • Design of 24x8 (16 byte) STACK. . Implementation of a 4-bit PROCESSOR.	24

Reference Books:

- D.W. Patterson , “Computer Organization and Design”, 4th **Edition**, Elsevier Publication, 2008.
- William Stalling , “Computer Organization”,8th Edition, PHI, 2011.
- M. Mano , “Computer System Architecture”, 3rd Edition, PHI.

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: After the completion of the course, the student will be able to:

- CO1: Implement the Combinational and Sequential Circuit.
- CO2: Demonstrate the working of counter and shift register.
- CO3: Demonstrate the working of ALU and seven segment displays.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO5/PSO2
CO2	PO3,PO4/PSO2
CO3	PO3,PO5/PSO1,PSO2

BCSC0805: DATA STRUCTURES & ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module	Content	Lab
I &II	• Program to implement various operations in a singly linked list. • Program to implement insertion, deletion and traversal in a doubly linked List. • Program to implement polynomial addition using linked list. • Program to demonstrate the various operations on stack. • Program to convert an infix expression into postfix expression. • Program to evaluate a given postfix expression. • Program to implement Tower of Hanoi problem using Recursion. • Program to demonstrate the implementation of various operations on linear and circular queue. • Program to demonstrate the implementation of insertion and traversals on a binary search tree. • Program to implement Dijkstra's Algorithm to find the shortest path between source and destination. • Program to search a given element as entered by the user using sequential and binary search to search a given element as entered by the user. • Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort. • To write the following recursive functions for a singly-linked NULL-terminated list: insert(), traverse(), search().	24

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

CSC0806: MICROPROCESSORS LAB

Objective: *The objective is to introduce the Architecture and programming of the microprocessor and learning about interfacing and various applications of microprocessor.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• To study 8085 microprocessor System. • To study 8086 microprocessor System. • To develop and run basic programs in 8085 ALP. • To develop and run programs in 8085 ALP related to the concept of looping, counting and indexing. • To perform interfacing of RAM chip to 8085/8086. • To perform interfacing of keyboard controller. • To perform interfacing of DMA controller. • To perform interfacing of UART/USART.	24

Reference Books:

- Ramesh S. Gaonkar, "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- D. V. Hall , "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After completion of course, student will be able to:

- CO1: Demonstrate the arithmetic and logical operations using assembly language programming (8085).
- CO2: Demonstrate the memory operations using assembly language programming (8085).
- CO3: Demonstrate the interfacing of Keyboard, DMA and UART controller.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO2/PSO1,PSO2
CO3	PO1,PO3,PO5/ PSO2

BCSC0807: DESIGN & ANALYSIS OF ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I& II	• Implementation of sorting algorithms: ○ Insertion Sort ○ Bubble Sort ○ Selection Sort ○ Divide and conquer approach: • Quick Sort • Merge Sort ○ Heap Sort ○ Counting Sort • Implementation of Searching Techniques: ○ Linear Search ○ Binary Search • Implementation of Matrix Multiplication • Implementation of Convex Hull • Implementation of Breadth First Search • Implementation of Depth First Search • Implementation of Greedy approaches: ○ Optimal Reliability Allocation. ○ Knapsack. Minimum ○ Minimum Spanning trees: • Prim's and Kruskal's algorithms. ○ Single source shortest paths – • Dijkstra's and Bellman Ford algorithms. • Implementation of Dynamic Programming: ○ Longest Increasing Subsequence. ○ Finding best path in maze. ○ Matrix Chain Multiplication ○ 0/1 Knapsack Problem ○ Resource Allocation Problem	32

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2.

Outcomes: After completion of course, student will be able to:

- CO1: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.
- CO2: Demonstrate and use the appropriate data structures for a given problem
- CO3: Implement the algorithms based on Greedy approach and Dynamic Programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO1,PSO2,PSO4
CO2	PO1,PO3,PO4/PSO1,PSO2,PSO3
CO3	PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0808: APPLIED DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL and NoSQL databases.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Introduction to MongoDB and its Installation on Windows or Linux, Description of mongo Shell, create database and show database, Commands for MongoDB and To study operations in MongoDB – Insert, Query, Update, Delete and Projection • To implement Database connectivity using Python	24

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan, "Database Concepts", 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, "Database Management System", TMH
- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

Focus: This Course focuses on Employability under CO1,CO2.

Outcomes: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Implement the procedural language (PL/SQL) and Triggers.
- CO3: Apply NoSQL queries in MongoDB.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO2,PO3,PO5/PSO2,PSO3
CO3	PO5/PSO2

BCSC0809: APPLIED DATA STRUCTURES & ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I&II	• Program to implement various operations in a singly linked list. • Program to implement insertion, deletion and traversal in a doubly linked List. • Program to demonstrate the various operations on stack. • Program to implement Tower of Hanoi problem using Recursion. • Program to demonstrate the implementation of various operations on linear and a • circular queue. • Program to implement Dijkstra's Algorithm to find the shortest path between source and • destination. • Program to search a given element as entered by the user using binary search (divide and • conquer approach) to search a given element as entered by the user. • Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Radix Sort, Bucket Sort. • Program to implement AVL Trees. • Program to implement Red-Black Trees. • Program to implement Binary Heaps. • Program to implement Priority Queues. • Program to implement Huffman Character Length Encoding. • Program to implement tree traversal using Backtracking. • Project to create a LogBook to generate a Calendar Display. • Project to create a Hangman game using String Lexical Analysis.	24

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree AVL Tree, Red- Black, and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

SYLLABUS

OF

PROGRAM ELECTIVE

BOUQUET: COMPUTER NETWORK & SECURITY

DEPARTMENT OF COMPUTER ENGINEERING & APPLICATIONS

Under

Choice Based Credit System (CBCS)

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet 1:Computer Network & Security									
Theory									
1.	BCSE0001	Network Programming and Management	3	0	0	0	3	3	Computer Networks
2.	BCSE0002	Principles of Mobile Computing	3	1	0	0	4	4	Computer Networks
3.	BCSE0003	Ad Hoc Networks	3	0	0	0	3	3	Computer Networks
4.	BCSE0004	Cryptography & Network Security	3	0	0	0	3	3	Computer Networks
5.	BCSE0005	Cyber security and Digital Forensics	3	0	0	0	3	3	
6.	BCSE0006	Information Coding Techniques	3	0	0	0	3	3	Computer Networks
Labs									
1.	BCSE0070	Network Programming and Management Lab	0	0	2	0	1	2	Computer Networks
2.	BCSE0071	Cryptography & Network Security Lab	0	0	2	0	1	2	Computer Networks
3.	BCSE0072	Cyber security and Digital Forensics Lab	0	0	2	0	1	2	
4.	BCSE0073	Information Coding Techniques Lab	0	0	2	0	1	2	Computer Networks
Projects									
1.	BCSE0081	Cyber security and Digital Forensics Project	0	0	0	-	2	0	

BCSE0001: NETWORK PROGRAMMING AND MANAGEMENT

Objective: *To learn the basics of socket programming using TCP Sockets and UDP sockets. To develop knowledge of threads for developing high performance scalable applications. To learn about raw sockets. To understand simple network management protocols & practical issues.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Socket Programming-**Overview of TCP/IP Protocols, Introduction to Sockets, Socket address Structures, Byte ordering functions, address conversion functions, Elementary TCP Sockets, socket, connect, bind, listen, accept, read, write, close functions, Iterative Server, Concurrent Server. **Application development:** TCP Echo Server, TCP Echo Client, Posix Signal handling, Server with multiple clients, boundary conditions: Server process Crashes, Server host Crashes, Server Crashes and reboots, Server Shutdown, I/O multiplexing, I/O Models, select function, shutdown function TCP echo Server (with multiplexing) - poll function - TCP echo Client (with Multiplexing).	20
II	**Socket options:** Socket options, get socket and set socket functions - generic socket options - IP socket options -ICMP socket options - TCP socket options. **Elementary UDP sockets:** Elementary UDP sockets - UDP echo Server - UDP echo Client - Multiplexing TCP and UDPsockets - Domain name system - gethostbyname function - Ipv6 support in DNS - gethostbyadr function - getservbyname and getservbyport functions. **Advanced sockets**: Ipv4 and Ipv6 interoperability - threaded servers - thread creation andtermination - TCP echoserver using threads - Mutexes - condition variables - raw sockets - raw socket creation - raw socket output - raw socket input - ping program - trace route program.	20

Text Books:

- Unix Network Programming Volume 1: The Sockets Networking API by W. Richard Stevens, Bill Fenner and Andrew M. Rudoff, Pearson Education

Reference Books:

- The Definitive Guide to Linux Network Programming by Keir Davis, John Turner and Nathan Yocom,
- TCP/IP Sockets in C: Practical Guide for Programmers by Michael J. Donahoo and Kenneth L. Calvert, Morgan Kaufmann

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: After completion of course, the student will be able to:

- CO1: Understand the basic Concepts of socket programming.
- CO2: Apply the socket constructs for application development.
- CO3: Understand the basics of get socket set socket, generic socket options.
- CO4: Understand the concepts of elementary UDP sockets.
- CO5: Demonstrate the working of threaded servers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO4/PSO1,PSO3
CO2	PO1,PO3/PSO2
CO3	PO1,PO3/PSO1
CO4	PO1,PO3/PSO1
CO5	PO1,PO4/ PSO3

BCSE0070: NETWORK PROGRAMMING AND MANAGEMENT LAB

Objective: *To understand the use of client/server architecture in application development, to understand and use elementary socket system calls, advanced socket system calls and how to use TCP and UDP based sockets to implement network routing algorithms and application layer protocols.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I& II	• Understanding and using of commands like ifconfig, netstat, ping, arp, telnet, ftp, finger, traceroute, whoisetc. • Usage of elementary socket system calls (socket (), bind (), listen (), accept (), connect (), send (), recv (), send to (), recvfrom ()). • Implementation of Connection oriented concurrent service (TCP). • Implementation of Connectionless Iterative time service (UDP). • Implementation of Select system call. • Implementation of gesockopt (), setsockopt () system calls. • Implementation of getpeername () system call. • Implementation of remote command execution using socket system calls. • Implementation of Distance Vector Routing Algorithm. • Implementation of SMTP. • Implementation of FTP. • Implementation of HTTP.	24

Reference Books:

- W. Richard Stevens, "Unix Network Programming", Prentice Hall, Pearson Education, 2009.
- Douglas E. Comer, "Hands-on Networking with Internet Technologies", Pearson Education.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: By the end of the class, students will learn to:

- CO1: Apply network-programming concepts to develop and implement distributed applications.
- CO2: Develop and implement next generation protocols required for emerging applications.
- CO3: Evaluate the performance of networking systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO6/PSO1,PSO4
CO2	PO1,PO3,PO5,PO6/PSO1,PSO4
CO3	PO2,PO3 /PSO3,PSO4

BCSE0002: PRINCIPLES OF MOBILE COMPUTING

Objective: To learn the cellular concepts and to know about the radio wave propagation along with various wireless techniques.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Hours
I	**Introduction to Mobile Communications and Computing:** Introduction to Mobile Computing, novel applications, limitations, and architecture - GSM Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services. **Introduction to wireless communication**: Evolution of mobile communications, mobile radio systems- Examples, trends in cellular radio and personal communications. Cellular Concept: Frequency reuse, channel assignment, hand off, Interference and system capacity, tracking and grade of service, Improving Coverage and capacity in Cellular systems. **Wireless radio propagation:** Free space propagation model, reflection, diffraction, scattering, link budget design, Outdoor Propagation models, Indoor propagation models.	20
II	**Wireless radio propagation:** Small scale Multipath propagation, Impulse model, Small scale Multipath measurements, parameters of Mobile multipath channels, types of small scale fading, statistical models for multipath fading channels., Interference, DSSS, FHSS. **Medium access control:** (Wireless) Medium Access Control: Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA. **Wireless LAN standards:** Wireless LAN, IEEE 802.11, Architecture, services MAC Physical layer, IEEE 802.11a, 802.11b standards, HIPERLAN, Bluetooth.	20

Text Books:

- Mobile Communications, 2nd Edition by Jochen Schiller, Pearson Education
- Handbook of Wireless Networks and Mobile Computing Edited by Ivan Stojmenović, John Wiley & Sons, Inc.

Reference Books:

- Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML by Reza B'Far, Cambridge University Press
- Fundamentals of Mobile and Pervasive Computing by Frank Adelstein, Sandeep KS Gupta, Golden Richard III and Loren Schwiebert, McGraw-Hill Professional
- 802.11 Wireless Networks: The Definitive Guide, 2nd Edition by Matthew Gast, O'Reilly Media

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: By the end of the class, students will learn to:

- CO1: Understand the basic concepts of mobile communication.
- CO2: Explain the concepts of mobile radio system and cellular system.
- CO3: Discuss the Free space, reflection and diffraction, propagation model.
- CO4: Explain the different fading models.
- CO5: Understand the different medium access techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7,PO10/PSO1,PSO4
CO2	PO1,PO7,PO10/PSO1,PSO4
CO3	PO1,PO6,PO7/PSO1,PSO4
CO4	PO1,PO4,PO7/PSO1,PSO4

CO5	PO1,PO2,PO6/PSO1,PSO4

BCSE0003: AD HOC NETWORKS

***Objective**: This course is offered for those who are interested in understanding and building systems support mechanisms for mobile computing systems including client-server web/database/file systems, and mobile ad hoc and sensor networks for achieving the goal of anytime, anywhere computing in wireless mobile environments.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Ad Hoc Wireless Networks:** Characteristics of MANETS, Applications of MANETS, Challenges. **Routing in MANETS:** Topology based versus position-based approaches, Topology based routing protocols, and position-based routing, other routing protocols. **Data Transmission in MANETS:**The broadcast storm, Multicasting, Geocasting. **TCP Over Ad Hoc Networks:**TCP protocol overview, TCP and MANETS, Solutions for TCP over Ad Hoc networks. **Basics of Wireless Sensors and Applications:** The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications.	20
II	**Data Retrieval in Sensor Networks:** Classification of WSNs, MAC Layer, Routing Layer, High Level ApplicationLayer Support, Adapting to the Inherent Dynamic Nature of WSNs. **Introduction:** Basic principles and challenges, past and ongoing VANET activities. Cooperative Vehicular Safety Applications Enabling technologies, cooperative system architecture, safety applications. Vehicular Mobility Modeling Random models. MAC Layer of Vehicular Communication Networks Proposed MAC approaches and standards, IEEE 802.11p. **VANET Routing protocols:** Opportunistic packet forwarding, topology-based routing, geographic routing. Standards and Regulations Protocol Stack, DSRCregulations and standards.	20

Text Books:

- Ad Hoc and Sensor Networks: Theory and Applications, Carlos de MoraisCordeiro and Dharma PrakashAgrawal, World Scientific Publications / Cambridge University Press,2006.
- Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science Imprint, Morgan Kauffman Publishers, 2005

Reference Books:

- Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy and B. S. Manoj, Pearson Education, 2004.
- Guide to Wireless Sensor Networks, SudipMisra, Isaac Woungang, and Subhas Chandra Misra, Springer International Edition, 2012.
- Wireless Mesh Networking, Thomas Krag and SebastinBuettrich, O'Reilly Publishers,2007.
- Wireless Sensor Networks – Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, 2010.
- Wireless Ad hoc Mobile Wireless Networks-Principles, Protocols and Applications, Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008.
- Wireless Ad hoc Networking, Shih-Lin Wu, Yu-Chee Tseng, Auerbach Publications, 2007
- Wireless Ad hoc and Sensor Networks–Protocols, Performance and Control, JagannathanSarangapani, CRC Press, 2007.

Focus: This Course focuses on Employability under CO1,CO2,CO4 & 3.

Outcomes: After completion of course, the student will be able to:

- CO1: Understand the concept of mobile ad hoc networks and their design and implementation issues.
- CO2: Demonstrate the proactive, on-demand, and hybrid routing mechanisms.
- CO3: Explain sensor networks and their characteristics.

- CO4: Understand the mechanism of data retrieval in wireless sensor networks.
- CO5: Understand the characteristics of VANETs.
- CO6: Understand the differences in routing mechanism in MANETs and VANETs

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO4
CO3	PO1,PO5,PO6/PSO1,PSO2
CO4	PO1,PO4/PSO2,PSO4
CO5	PO1,PO2/PSO1,PSO4
CO6	PO1,PO5/PSO2,PSO4

BCSE0004: CRYPTOGRAPHY & NETWORK SECURITY

***Objective**: This Course focuses towards the introduction of network security using various cryptographic algorithms and understanding network security applications and practical applications that have been implemented and are in use to provide email and web security*.

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to Security Attacks, Services and Mechanism, Classical Encryption Techniques-Substitution Ciphers and Transposition Ciphers, Steganography, Stream and Block Ciphers, Cryptanalysis. **Symmetric Key Cryptosystems:** Block Cipher Principles, Shannon's Theory of Confusion and Diffusion, Data Encryption Standard(DES), Strength of DES, Triple DES, Advance Encryption Standard (AES), Linear and Differential Cryptanalysis, Block Ciphers Modes of Operation. **Introduction to Number Theory:** Modular Arithmetic, Prime and Relative Prime Numbers, Primitive Roots, Fermat's and Euler's Theorem, Extended Euclidean Algorithm, Chinese Remainder Theorem. **Algebraic Structures:** Introduction to Group, Ring & Field of the Form GF(P). Asymmetric Key Cryptosystems: RSA Cryptosystem, Attacks on RSA, Security of RSA, Discrete Logarithm Problem, Elgamal Encryption Algorithm. **Hash Functions and Macs:** Authentication Functions, Message Authentication Code, Hash Functions, Birthday Attacks, Security of Hash Functions, Secure Hash Algorithm (SHA-512).	20
II	**Digital Signature:** Digital Signatures, RSA Digital Signature Scheme, Elgamal Digital Signature Techniques, Digital Signature Standards(DSS). **Key Management:** Symmetric Key Distribution, Diffie Hellman Key Exchange Algorithm. **Public Key Distribution:** X.509 Certificates, Public Key Infrastructure. **Authentication Applications and E-Mail Security:** Kerberos, Pretty Good Privacy (PGP), S/MIME. **IP Security and Web Security:** IP Sec Architecture, Authentication Header, Encapsulating Security Payloads, Combining Security Associations, Key Management, Introduction to Secure Socket Layer, Transport Layer Security, Secure Electronic Transaction (SET). **System Security:** Introductory Idea of Intrusion, Intrusion Detection, Malicious Programs, Firewalls.	22

Text Books:

- W. Stallings , "Cryptography and Network Security: Principles and Practices",5th Edition, Pearson Education,2010.

Reference Books:

- B. A. Forouzan, "Cryptography & Network Security", 3rd Edition, Tata McGraw Hill,2003.
- Wenbo Mao , "Modern Cryptography: Theory and Practice", Prentice Hall,2003.
- Douglas Stinson, "Cryptography Theory and Practice", 2nd Edition, Chapman& Hall/CRC.

Focus: This Course focuses on Employability under CO1,CO2,CO4 & 3.

Outcomes: After completion of course, the student will be able to:

- CO1: Understands the basic concepts of cryptography.
- CO2: Apply the symmetric key concepts of DES and AES for securing data.
- CO3: Apply the concepts of number theory of Asymmetric key cryptosystem.
- CO4: Understand the concepts of hash function, MAC and digital signature for data integrity.
- CO5: Explain the symmetric and asymmetric key distribution techniques.
- CO6: Understand the concepts of security mechanism at TCP/IP layer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO5,PO12/PSO2,PSO3
CO2	PO1,PO2,PO3,PO12/PSO1,PSO2
CO3	PO1,PO2,PO4,PO5,PO6/PSO1,PSO4
CO4	PO1,PO2,PO3,PO5,PO6/PSO1,PSO3
CO5	PO1,PO2,PO6,PO12/PSO1,PSO4
CO6	PO1,PO2,PO6,PO12/PSO1,PSO4

BCSE0071: CRYPTOGRAPHY & NETWORK SECURITY LAB

Objective: *The objective of this lab is that to understand the principles of encryption algorithms, conventional and public key cryptography practically with real time applications.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Hours
I& II	• Write a program in ‘C’ to implement Additive and VignereCipher. • Write a program in ‘C’ to implement Autokey Cipher. • Write a program in ‘C’ to find out the Multiplicative inverse of a given number. • Write a program in ‘C’ to implement RSA Cryptosystem. • Write a program in ‘C’ to implement Elgamal Cryptosystem. • Write a program in ‘C’ to implement Rabin Miller Primality Test. • Write a program in ‘C’ to find out the Primitive roots. • Write a program in ‘C’ to implement Euclidean Algorithm. • Write a program in ‘C’ to implement Extended Euclidean Algorithm. • Write a program in ‘C’ to implement Diffie-Hellman key exchange Algorithm. • Write a program in ‘C’ to implement Random Number Generator.	24

Textbooks:

- W. Stallings , "Cryptography and Network Security: Principles and Practices",5th Edition, Pearson Education,2010.

Reference Books:

- B. A. Forouzan, "Cryptography & Network Security", 3rd Edition, Tata McGraw Hill,2003.
- Douglas Stinson, "Cryptography Theory and Practice", 2nd Edition, Chapman& Hall/CRC.
- K. N. King, “C Programming a Modern Approach”, W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, “The C Programming Language”, PHI, 2nd Edition, 2011.
- P.DeyandM.Ghosh, “ProgramminginC”, OxfordUniversityPress1st Edition,2000.

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: After completion of this course students will be able to:

- CO1: Implement symmetric key encryption algorithms.
- CO2: Implement Asymmetric key encryption algorithms.
- CO3: Implement the concepts of number theoryAsymmetric key cryptosystem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO6,PO12/PSO1,PSO4
CO2	PO1,PO2,PO6,PO12/PSO1,PSO4
CO3	PO1,PO3,PO4,PO6,PO12/PSO1,PSO4

BCSE0005: CYBERSECURITY AND DIGITAL FORENSICS

Objective: *To give knowledge of constitutional and case law to search and capture digital evidence, determine the most effective and appropriate forensic response strategies to digital evidence, and provide effective proof in a case involving digital evidence.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: Social Engineering, Categories of Cyber Crime, Property Cyber Crime. **Cyber Security issues:** Unauthorized Access to Computers, Computer Intrusions, White Collar Crimes, Viruses and Malicious Code ,Security Engineering ,Network Security ,Information Security, Web Security, Database Security, Malware Security, Biometric Security, Security in Cloud Computing and Mobile Computing. Software Piracy, Intellectual Property, Digital laws and legislation, Law Enforcement Roles and Responses. **Investigation:** Introduction to Cyber Crime Investigation - Investigation Tools Discovery - Digital Evidence Collection, Evidence Preservation, E-Mail Investigation	24
II	Tracking - IP Tracking, E-MailRecovery, Hands on Case Studies, Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking. **Digital forensics:** Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics. **Laws and acts:** Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC, Electronic Communication Privacy ACT, Legal Policies.	24

Text Books:
- Guide to Computer Forensics and Investigations 6th Edition by Bill Nelson, Amelia Phillips and Christopher Steuart, Cengage Publication
- Incident Response & Computer Forensics, Second edition by Chris Prosise and Kevin Mandia, McGraw-Hill Education

Reference Books:
- Computer Forensics and Digital Investigation with EnCase Forensic v7 1st Edition by Suzanne Widup, McGraw-Hill Education
- Forensic Computer Crime Investigation by Thomas A. Johnson, CRC Press
- Software Forensics: Collecting Evidence from the Scene of a Digital Crime 1st Edition by Robert Slade, McGraw-Hill Education

Focus: This Course focuses on Employability under CO1,CO2,CO4.

Outcomes: After completion of course, the student will be able to:
- CO1: Understand the basics of cyber security.
- CO2: Explain the basic concepts of System security.
- CO3: Understand the different investigation mechanism of cyber security.
- CO4: Explain the digital forensics in system security.
- CO5: Illustrate the laws and acts in cyber domain.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO6,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO4,PO5/PSO1,PSO4
CO3	PO1,PO3,PO4,PO6/PSO1,PSO3,PSO4
CO4	PO1,PO2,PO5/PSO1,PSO3
CO5	PO1,PO3,PO5/PSO1,PSO3

BCSE0072: CYBER SECURITY AND DIGITAL FORENSICS LAB

Objective:

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Hours
I& II	• Working on footprinting and Reconnaissance of a network and server. • Enumeration for network resources and enumerating local machines. • Scanning Networks and finding vulnerabilities and exploit cases. • Working on System Hacking and bypassing first line of security (passwords /Encryption) • Password hacking techniques like Brute force and Rainbow Attack. • Working with viruses and malware. • Packet Sniffing and network traffic analysis using wireshark. • Manipulating person mindset using Social Engineering and its detection techniques. • Attacking web applications and servers using various Denial-of-Service attacks. • Vulnerability Assessment of web applications using Nikto / Nessus/WPScanner • Vulnerability Assessment of wireless networks using Fluxion / Aircrack-ng	24

Textbooks:

- "Gray Hat Hacking the Ethical Hackers Handbook, 3rd Edition" by Allen Harper and Shon Harris

Reference Books:

- "The Unrevealed Secrets of Hacking and Cracking – Hack Before You Get Cracked" by Prateek Shukla and NavneetMehra
- "How to Unblock Everything on the Internet" by Ankit Fadia
- "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, 2ed" by DafyddStuttard and Marcus Pinto

Focus: This Course focuses on Employability under CO1,CO2.

Outcomes: After completion of this course students will be able to:

- CO1: Implement the reconnaissance attacks of cyber security.
- CO2: Implement the access attacks of cyber security.
- CO3: Identify vulnerability of web applications and wireless networks.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO5/PSO1,PSO4
CO2	PO1,PO2,PO3,PO5/PSO1,PSO4
CO3	PO1,PO2,PO3,PO5/PSO1,PSO4

BCSE0006: INFORMATION CODING TECHNIQUES

Objective: *To introduce the fundamental concepts of information theory: data compaction, data compression, data transmission, error detection and correction.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Information entropy fundamentals** Uncertainty, Information and Entropy - Source Coding Theorem - Huffman coding – Shannon Fano coding - Discrete Memory less channels - channel capacity - channel coding Theorem - Channel Capacity Theorem. **Data and voice coding** Differential Pulse Code Modulation - Adaptive Differential Pulse Code Modulation - Adaptive sub band coding - Delta Modulation - Adaptive Delta Modulation - Coding of speech signal at low bit rates (Vocoders, LPC). **Error control coding** Linear Block codes - Syndrome Decoding - Minimum distance consideration - cyclic codes -Generator Polynomial - Parity check polynomial - Encoder for cyclic codes - calculation of syndrome - Convolutional codes.	20
II	**Compression techniques - text** Principles - Text compression - Static Huffman Coding - Dynamic Huffman coding - Arithmetic coding. **Compression techniques - multimedia** Image Compression - Graphics Interchange format - Tagged Image File Format - Digitized documents - Introduction to JPEG standards. **Audio and video coding** Linear Predictive coding - code excited LPC - Perceptual coding, MPEG audio coders – Dolby audio coders - Video compression - Principles - Introduction to H.261 & MPEG Video standards.	20

Text Books:

- Communication Systems, 5th Edition by Simon Haykin and Michael Moher, Willey
- Multimedia Communications: Applications, Networks, Protocols and Standards by Fred Haskell, Pearson Education India

Reference Books:

- Multimedia Communications: Directions and Innovations, 1st Edition, by Jerry Gibson, Academic Press
- Information Theory and Network Coding by Raymond W. Yeung, Springer
- Fundamentals of Information Theory and Coding Design by Roberto Togneri and Christopher J.S deSilva, Chapman and Hall/CRC

Focus: This Course focuses on Employability under CO1,CO2,CO4.

Outcomes: After completion of course, the student will be able to:

- CO1: Understand the fundamentals of information coding techniques.
- CO2: Apply the modulation technique for encoding data and voice.
- CO3: Apply the error detection and correction techniques for error elimination.
- CO4: Apply the compression techniques for multimedia data.
- CO5: Understand the audio and video coding standards for data representations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO5/PSO1,PSO4
CO2	PO1,PO2,PO3,PO4,PO5/PSO1,PSO4
CO3	PO1,PO3,PO12/PSO1,PSO4
CO4	PO1,PO2,PO3,PO4,PO5/PSO1,PSO4
CO5	PO1,PO5,PO6,PO12/PSO1,PSO3

BCSE0073: INFORMATION CODING TECHNIQUES LAB

Objective: *To understand and implement the fundamental concepts of information theory: data compaction, data compression, data transmission, error detection and correction .*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Hours
I& II	• Write a program for determination of various entropies and mutual information of a given channel. Test various types of channel such as a) Noise free channel. b) Error free channel c) Binary symmetric channel d) Noisy channel Compare channel capacity of above channels. • Write a program for generation and evaluation of variable length source coding (Any two) a) Shannon Fano coding and decoding b) Huffman Coding and decoding c) Lempel Ziv Coding and decoding • Write a Program for coding & decoding of Linear block codes. • Write a Program for coding & decoding of Cyclic codes. • Write a program for coding and decoding of convolutional codes. • Write a program for coding and decoding of BCH and RS codes. • Write a program to study performance of a coded and uncoded communication system (Calculate the error probability). • Write a simulation program to implement source coding and channel coding for transmitting a text file. • Implementation of any compression algorithm for either audio, image or video data.	24

Reference Books:

- Ranjan Bose, "Information Theory coding and Cryptography", McGraw-Hill Publication, 2ndEdition
- C Moreira, P G Farrell, "Essentials of Error-Control Coding", Wiley Student Edition
- BernadSklar, "Digital Communication Fundamentals & applications", 2ndEd. Pearson Education.
- Shu lin and Daniel j, Cistellojr., "Error control Coding" Pearson, 2nd Edition.
- Todd Moon, "Error Correction Coding: Mathematical Methods and Algorithms", Wiley Publication
- Khalid Sayood, "Introduction to data compression", Morgan Kaufmann Publishers

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcomes: By the end of the class, students will learn to:

- CO1: Implement the coding and decoding techniques of multimedia data.
- CO2: Implement the error detection and correction technique for multimedia data.
- CO3: Implement the compression algorithms for image audio and video.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO6/PSO1,PSO4
CO2	PO1,PO3,PO5,PO6/PSO1,PSO4
CO3	PO1,PO3,PO5 /PSO1,PSO4

BCSE0086: CYBERSECURITY AND DIGITAL FORENSICS PROJECT

Objective: *To provide students with a comprehensive overview of collecting, investigating, preserving, and presenting evidence of cybercrime left in digital storage devices.*

Credits: 02 **L–T–P-J: 0–0–0-0**

1. **Data Forensics:**
   Objective: Find and analyze hiddendata from slack, swap and dead spaces on small devices (PDAs, phones ,USB sticks, etc.)
2. **Honeypots:**
   Objective: Configure a honeypot and analyze the collected target data with and from honeypots.
3. **Malware analysis:**
   Objective: Analyze of malware using static and dynamic/behavioral methods and use it for malware detection, mitigation, the development of countermeasures
4. **Dynamic Binary Instrumentation**:
   Objective: Use of software testing measures such as code coverage, Function callhooking, control flow analysis, dynamic binary instrumentation helps ensure that an adequate slice of the program's set of possible behaviors has been observed.
5. **Steganalysis**:
   Objective: Perform Steganalysison a JPEG Image Using Variation Techniques. Find and analyze hidden data from the image.
6. **Mobile Forensics**:
   Objective: Investigate into a Factory Reset of Android Device. Find and analyze hidden data from the device.
7. **Network Forensics**:
   Objective: Find different logs on the network and analyze to close the defined problem.
8. **Capturing volatile and non-volatile information**:
   Objective: Capture information from different files systems. Simple and extended attributes, erased data, file reassembly.

SYLLABUS

OF

PROGRAM ELECTIVE

BOUQUET: SOFTWARE ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING & APPLICATIONS

Under

Choice Based Credit System (CBCS)

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet:Software Engineering									
THEORY									
1.	BCSE0051	Software Quality Engineering	3	0	0	0	3	3	Software Engineering
2.	BCSE0052	Service Oriented Architecture	3	0	0	0	3	3	Software Engineering
3.	BCSE0053	Agile Software Development	3	0	0	0	3	3	Software Engineering
4.	BCSE0054	Software Project Management	3	0	0	0	3	3	Software Engineering
5.	BCSE0055	Software Testing	3	0	0	0	3	3	Software Engineering
6.	BCSC0013	Compiler Design	3	1	0	0	4	4	TAFL

BCSE0051: SOFTWAREQUALITY ENGINEERING

Prerequisite: *Exposure to basic concepts of software engineering*

Credits: 03 **L–T–P-J: 3–0–0-**

Module No.	Content	Teaching Hours
I	**Software Quality:** Software Quality Attributes and Specification, Total Quality Management, ISO 9126 Quality Standards; Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction, and Containment, Overview of Different Types of Software Review. **Software Quality Metrics:** Product Quality Metrics- Defect Density, Customer Problems Metric, Customer Satisfaction Metrics, Function Points; In-Process Quality Metrics- Defect Arrival Pattern, Phase-Based Defect Removal Pattern, Defect Removal Effectiveness; Metrics for Software Maintenance- Backlog Management Index, Fix Response Time, Fix Quality, Software Quality Indicators. **Software Quality Assurance:** Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities/Issues, Zero Defect Software.	20
II	**Software Testing:** Functional Testing - Boundary Value Testing, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Techniques; Structural Testing- Path Testing, Data Flow Testing. **Test Selection & Minimization for Regression Testing:** Regression Testing, Regression Test Process, Initial Smoke or Sanity Test, Selection of Regression Tests, Classifying Test Cases, Methodology for Selecting Test Cases, Resetting the Test Cases for Regression Testing; Introduction to Ad-Hoc Testing. **Testing Web Applications:** Web testing, Functional Testing, User Interface Testing, Usability Testing, Configuration and Compatibility Testing, Security Testing, Performance Testing, Database Testing, Post-Deployment Testing, Web Metrics; Introduction to Automated Test Data Generation.	19

Text Book:

- Stephen H. Kan, "Metrics and Models in Software Quality Engineering", 2nd Edition, Pearson Education,2000.
- Yogesh Singh , "Software Testing", Cambridge University Press,2011.

Reference Books:

- Jeff Tian , "Software Quality Engineering (SQE)", Wiley-Interscience,2005
- S. Desikan and G. Ramesh , "Software Testing: Principles and Practices", Pearson Education,2008
- Aditya P. Mathur, "Fundamentals of Software Testing", Pearson Education,2011
- NareshChauhan, "Software Testing: Principles and Practices", 1st Edition, Oxford University Press,2010.
- Naik and Tripathy, "Software Testing and Quality Assurance", Wiley India,2008.

Focus: This Course focuses on Employability, Skill Development and Entrepreneurship under CO1,CO2,CO3,CO5.

Outcomes: After the completion of this syllabus, the student will be able to:

- CO1: Evaluate alternative standards, models and techniques aimed for quality software to achieve the satisfaction of the client as well as developer.
- CO2: Propose the innovative solutions for the software quality assurance and measurement problems in the context of various software development environments.
- CO3: Evaluate software quality assurance issues in software development and propose the quality framework for an organization.
- CO4: Write the software test scenarios, test cases, test plans and various metrics of different applications.
- CO5: Perform the testing of web based projects in team.

- CO6: Apply the suitable methodology to perform regression testing in projects.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO4,PO6/PSO4
CO2	PO2,PO3/PSO1,PSO4
CO3	PO11,PO12/PSO4
CO4	PO1,PO5,PO6/PSO1
CO5	PO1,PO5/PSO2
CO6	PO1,PO6/PSO1,PSO4

BCSE0052: SERVICE ORIENTED ARCHITECTURE

Prerequisite: *Exposure of distributed systems*

Credits: 03 L–T–P-J: 3–0–0-

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to Web 1.0, 2.0, Web Services (WS), Characteristics of Web Services, WS Modeling Web Service Activities, WS Management, WS Composition, Service Descriptions; Introduction to Service Oriented Architecture (SOA), Characteristics Of SOA, Principles of SOA, Comparison of Service and Object Orientation, SOA Interaction Cycle (SIC), Comparing SOA to Client Server and Distributed Internet Architectures, Components of SOA; Patterns Coordination, Atomic Transactions, Business Activities, Orchestration, Choreography, Service Layer Abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer. **Service Oriented Analysis:** Business Centric SOA, Deriving Business Services, Service Oriented Design, WSDL Basics, SOAP Basics, Messaging with SOAP, Message Exchange.	20
II	**SOA Composition, Guidelines:** Entity Centric Business Service Design, Application Service Design, Task Centric Business Service Design, SOA Platforms - SOA Support in J2EE, Java API for XML Based Web Services (JAX,WS). **WS Integration concepts:** Concepts of Enterprise Service Bus (ESB), Web Services Interoperability Technologies (WSIT), SOA Support in .NET, Common Language Runtime, ASP.NET Web Forms, ASP.NET Web Services, Web Services Enhancements (WSE), Concepts of Business Process Execution Language (BPEL).	19

Text Book:

- Thomas Erl, “SOA Principles of Service Design” The Prentice Hall Service Oriented Computing Series, Prentice Hall India, 2008.

Reference Books:

- Newcomer, Lomow, “Understanding SOA with Web Services”, Pearson Education, 2005.
- Sandeep Chatterjee, James Webber , “Developing Enterprise Web Services: An Architect’s Guide”, Pearson Education, 2005.
- Munindar P. Singh, Michael N. Huhns, “Service-Oriented Computing: Semantics, Processes Agents”, Wiley, 2010.
- Dan Woods and Thomas Mattern, “Enterprise SOA Designing IT for Business Innovation”, 1st Edition, O’Reilly, 2006.

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO6.

Outcomes: After completion of the course, students will be able to:

- CO1: Understand the concept of service oriented architecture.
- Co2:Compare service oriented architecture with client server, and distributed internet architectures.
- CO3: Understand the concept of service oriented analysis.
- CO4: Understand the SOA Composition and Guidelines.
- CO5: Demonstrate the use of java API for XML based services.
- CO6: Understand the WS Integration concepts.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO3
CO3	PO2/PSO3
CO4	PO3/PSO1
CO5	PO3,PO5/PSO4

CO6	PO4,PO5/PSO4

BCSE0053: AGILE SOFTWARE DEVELOPMENT

Prerequisite: *Exposure of Software Engineering Principles*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Fundamentals of Agile:** The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools **Agile Scrum Framework:** Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management **Agile Software Design:** Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design,	26
II	**Agile Software Development:** Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control. Current researches in Agile software development **Agile Testing:** The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agiletester **Industry Trends:** Market scenario and adoption of Agile, Agile ALM, Roles in an Agile project, Agile applicability, Agile in Distributed teams, Business benefits, Challenges in Agile, Risks and Mitigation, Agile projects on Cloud, Balancing Agility with Discipline, Agile rapid development technologies	26

Text Book:

- Ken Schawber& Mike Beedle, Agile Software Development with Scrum, Pearson, 2008

Reference Books:

- KenSchawber & MikeBeedle, AgileSoftware Development with Scrum,Pearson,2008
- RobertC.Martin , Agile Software Development ,Principles, Patterns and Practices, Prentice Hall,2002
- Lisa Crispin & JanetGregory, AgileTesting: A Practical Guide for Testers and Agile Teams, Addison Wesley,2008
- Alistair Cockburn, Agile Software Development: The Cooperative Game ,Addison Wesley ,2006

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: After completion of the course, students will be able to:

- CO1: UnderstandthesignificanceofAgileMethodologiesinsoftwaredevelopment.
- CO2: Compare and contrast the different agile methods.
- CO3: Determine the suitability of agile methods for a particular Project.

- CO4:Evaluate how well a project is following agile principles, and assist the project to become moreagile (where appropriate).
- CO5: Understand the relationship between the customer and the development team in agile projects and the responsibilities of both communities.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3,PO5,PO7,PO10/PSO1,PSO4
CO2	PO2,PO4,PO9/PSO2,PSO4
CO3	PO2,PO6,PO11/PSO1,PSO4
CO4	PO1,PO2,PO4/PSO1,PSO3
CO5	PO8,PO9,PO10,PO11/PSO2

BCSE0054: SOFTWARE PROJECT MANAGEMENT

Prerequisite: *Exposure of SoftwareEngineering Principles*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Project Management:** The characteristics of software projects, Objectives of project management: time, cost and quality, Basics of Project Management, Feasibility Study, Cost-benefit Analysis, Planning, Project Execution, Project and Product Life Cycles, Project Management Knowledge areas, Project Management Tools & Techniques. **Project Management & Planning:** System view of project management, Understanding organizations, stakeholder's management, project phases & project life cycles. Introduction to Agile software, why planning is necessary, Iterative steps for planning, Project Plan documentation methods, Software Requirement Specification. **Measurement and Control:** Measurements for project monitoring, what and when to measure, Plan versus Control, managing the plan, Deadline Effect. Reviews, feedback and reporting mechanisms, revisiting the plan. Project Scope Management: Scope Planning & Scope management plans, Function point calculation, Scope definitions & project scope statement, Work Breakdown Structure (WBS)	20
II	**Time Management:** Project time management, activities sequencing, network diagrams, activity recourse estimation, activity duration estimation, schedule development, Gantt Charts, Critical path method, Program evaluation & review technique (PERT) and CPM. **Project Cost management:** Basis principles of cost management, Cost estimating, type of cost estimate, cost estimate tools & techniques, COCOMO, Putnam/ SLIM model Estimating by Analogy, cost budgeting, cost control, earned value management, project portfolio management **Project Quality Management:** Quality Planning, quality Assurance, Quality control, Tool &techniques for quality control, Pareto Analysis, Six Sigma, CMM **Project Communication Management**: Communication Planning, Performance reporting, managing stakeholders, improving project communication **Project risk management**: Risk Management planning, common sources of risk, risk identification, risk register, qualitative risk analysis, using probability impact matrixes, risk monitoring & control.	19

Text Book:

- Bob Hughes and Mike Cotterell, "Software Project Management", Tata McGraw Hill ,2009.
- Daniel Galin, "Software Quality Assurance: from Theory to Implementation", Addison-Wesley, 2003.

Reference Books:

- Roger Pressman, A practitioner's Guide to Software Engineering, Tata McGraw Hill ,2014
- Andrew Stellman; Jennifer Greene, Applied Software Project Management, O'Reilly Media, Inc. 2000.
- Ramesh Gopalaswamy, "Managing and global Software Projects", Tata McGraw Hill Tenth Reprint, 2011.

Focus: This Course focuses on Employability , Development and Entrepreneurship under CO1,CO3,CO4.

Outcomes: After completion of the course, students will be able to:

- CO1: Understand the basics of software project management.
- CO2: Understand the concept behind the planning, scope and feasibility of a project.
- CO3: Identify the theoretical and methodological issues involved in modern software engineering project management.
- CO4: Analyze various project estimation techniques, especially size estimation (FP), effort estimation (COCOMO models), schedule estimation (GANTT charts), and cost estimation.
- CO5: Understand the concept of time and cost Management in a project life cycle
- CO6: Understand Project Communication Management and Project Risk Management.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1,PSO4
CO3	PO2/PSO3
CO4	PO1,PO2/PSO3
CO5	PO1,PO2/PSO1,PSO4
CO6	PO1/PSO1

BCSE0055: SOFTWARE TESTING

Prerequisite: *Exposure to basic concepts of software engineering*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Testing Basics** Testing as an Engineering Activity – Role of Process in Software Quality – Testing as a Process – Basic Definitions – Software Testing Principles – The Tester's Role in A Software Development Organization – Origins of Defects – Defect Classes – The Defect Repository and Test Design – Defect Examples – Developer / Tester Support for Developing a Defect Repository. **Test Case Design** Introduction To Testing Design Strategies – The Smarter Tester – Test Case Design Strategies – Using Black Box Approach To Test Case Design – Random Testing – Equivalence Class Partitioning – Boundary Value Analysis – Other Black Box Test Design Approaches – Black Box Testing And Cots – Using White Box Approach To Test Design – Test Adequacy Criteria – Coverage And Control Flow Graphs – Covering Code Logic – Paths – Their Role In White Box Based Test Design – Additional White Box Test Design Approaches – Evaluating Test Adequacy Criteria. **Levels of Testing** The Need for Levels of Testing – Unit Test – Unit Test Planning – Designing The Unit Tests – The Class as A Testable Unit – The Test Harness – Running The Unit Tests and Recording Results – Integration Tests – Designing Integration Tests – Integration Test Planning – System Test – The Different Types – Regression Testing – Alpha, Beta and Acceptance Tests.	20
II	**Test Management** Basic Concepts – Testing, Debugging Goals, Policies – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – Reporting Test Results – The Role Of Three Groups In Test Planning And Policy Development – Process And The Engineering Disciplines – Introducing The Test Specialist – Skills Needed By A Test Specialist – Building A Testing Group. **System Testing** Integration Testing, System Testing, Interaction Testing, Performance Testing, Mutation Testing, Regression Testing, Error Seeding **Object Oriented Testing** Issues In Object Oriented Testing, Test Case Design By Object Oriented Software, Fault Based Testing, Test Cases And Class Hierarchy, Scenario Based Test Design, Testing Surface Structure And Deep Structure, Class Testing: Random Testing For Object Oriented Classes, Partition Testing At The Class Level; Inter Class Test Case Design: Multiple Class Testing, Tests Derived From Behavior Models, Test Case Generation Using Uml Diagrams, Gui Testing, Object Oriented System Testing.	19

Text Book:

- SrinivasanDesikan, Gopalaswamy Ramesh, "Software Testing: Principles andPractices", Pearson 2012
- C. J. Paul, Software testing: A craftsmen's approach, CRC Press, 2nd Ed, 2002.
- R. Gopalswamy, Software testing, Pearson, 2005.

Reference Books:

- Aditya P. Mathur, “Foundations of Software Testing”, Pearson, 2008
- Paul Ammann, Jeff Offutt, “Introduction to Software Testing”, CambridgeUniversity Press, 2008
- G. J. Myers, the art of software testing, Wiley Interscience New York, 2005.
- R. S. Pressman, Software Engineering a Practitioner’s approach, McGraw Hill, 4th Ed, 1982.
- R. Mall, Fundamentals of Software Engineering, Prentice Hall of India, 2nd Ed, 2003.

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: After completion of the course, students will be able to:

- CO1: Understand the basics of software Testing.
- CO2: Design various test cases for quality improvement.
- CO3: Understand different levels of software testing.
- CO4: understand the management process behind testing.
- CO5: understand concept of system testing.
- CO6: understand concept of Object Oriented System Testing.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO11/PSO1
CO2	PO3,PO5/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO3
CO4	PO1,PO2/PSO1,PSO3
CO5	PO1,PO2/PSO2,PSO3
CO6	PO1,PO2,PO4/PSO1,PSO3

BCSC0013: COMPILER DESIGN

Objective: *The course objective is to introduce the major concept areas of language translation and compiler design and to enrich the knowledge in various phases of compiler ant its use, code optimization techniques, machine code generation, and use of symbol table.*

Credits:04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Compiler:** Phases and passes, bootstrapping, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical analyzer generator, LEX-compiler, YACC, Context free grammars, derivation and parse trees, capabilities of CFG. **Basic Parsing Techniques:** Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables. **Advance Parser:** Constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.	20
II	**Syntax-directed Translation:** Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array Reference, Cases: in arithmetic expressions, procedures call, declarations and case statements. **Symbol Tables:** Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack allocation scheme, Storage allocation in block structured language. **Error Detection & Recovery:** Lexical Phase errors, Syntactic phase errors, semantic errors. **Code optimization:** Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, Value numbers and algebraic laws, Global Data-Flow analysis. **Code Generation:** Design Issues, Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator.	20

Text Book:

- Aho, Sethi& Ullman , "Compilers: Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2008.

Reference Books:

- V Raghvan, "Principles of Compiler Design", 2nd Edition, TMH, 2010.
- Kenneth Louden , "Compiler Construction", 1st Edition, Cengage Learning, 1997.
- Charles Fischer and Ricard LeBlanc , "Crafting a Compiler with C", Pearson Education, 2005

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After the completion of the course, the student will be able to:

- CO1: Understand basics of Compilers and its phases.
- CO2: Design top-down and bottom-up parsers and will be able to solve problems related to predictive parser, Shift reduce parsing, compute FIRST and FOLLOW sets, LR(0), LR(1) and LALR sets of items and parse table for a given grammar.
- CO3: Demonstrate the ability to write syntax directed translations of simple statements and understand the working of procedure calls.

- CO4: Demonstrate the ability to write intermediate code for a given high level programming language (preferably C or FORTRAN) and be able to represent the intermediate code as Quadruples, Triples and Indirect Triples
- CO5: Identify the basic blocks for three address code, draw flow graphs and represent directed acyclic graphs for the identified basic blocks.
- CO6: Write the target optimized code (assembly code) for the given three-address code.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO4/PSO1,PSO2,PSO3
CO2	PO1,PO2,PO3,PO4,PO5/PSO1,PSO2,PSO3
CO3	PO1,PO2,PO3,PO4/PSO1,PSO2,PSO3
CO4	PO1,PO2,PO3,PO5/PSO1,PSO2,PSO3
CO5	PO1,PO2,PO3,PO4,PO5/PSO1,PSO2,PSO3
CO6	PO1,PO2,PO3,PO4,PSO5/PSO1,PSO2,PSO3

SYLLABUS

OF

PROGRAM ELECTIVE

BOUQUET: IMAGE PROCESSING AND INTELLIGENT SYSTEM

DEPARTMENT OF COMPUTER ENGINEERING & APPLICATIONS

Under

Choice Based Credit System (CBCS)

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Image Processing and Intelligent System									
Theory									
1.	BCSE0101	Digital Image Processing	3	0	0	0	3	3	Mathematics, Programming
2.	BCSE0102	Computer Graphics and Multimedia	3	1	0	0	4	4	Mathematics, Programming
3.	BCSE0103	Soft Computing	3	0	0	0	3	3	Discrete Mathematics
4.	BCSE0104	Artificial Intelligence	3	0	0	0	3	3	Data Structures
5.	BCSE0105	Machine Learning	3	0	0	0	3	3	Mathematics, Programming
6.	BCSE0106	Machine Learningand Its Applications	3	0	0	0	3	3	Mathematics, Programming
Labs									
1.	BCSE0131	Digital Image Processing Lab	0	0	2	0	1	2	Programming
2.	BCSE0132	Soft Computing Lab	0	0	2	0	1	2	Programming
4.	BCSE0133	Machine Learning Lab	0	0	2	0	1	2	Programming
Projects									
1.	BCSE0141	Machine Learning Project	0	0	0	-	2	-	Programming

BCSE0101: DIGITAL IMAGE PROCESSING

Objective: *The objective is to introduce students the Fundamentals of digital Image processing. Students should study the basic of image operations and understand image analysis algorithm. Students can have exposure to current applications in the field of digital image processing*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction and Fundamentals:** Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization, Some Basic Relationships between Pixels. **Intensity Transformations and Spatial Filtering:** Introduction, Some Basic Intensity Transformation Functions, Histogram Processing, Histogram Equalization, Histogram Specification, Local Enhancement, Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging, Basics of Spatial Filtering, Smoothing - Mean Filter, Order Statistics Filters, Sharpening – The Laplacian. **Filtering in the Frequency Domain:** Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain.	20
II	**Morphological Image Processing:** Introduction, Logical Operations involving Binary Images, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening. **Image Segmentation:** Point, Line & Edge detection, Thresholding, Region-based Segmentation, Region Extraction - Pixel Based Approach & Region Based Approach, Edge and Line Detection - Basic Edge Detection, Canny Edge Detection, Edge Linking - Hough Transform. **Representation & Description:** Representation - Boundary Following, Chain Codes; Boundary Descriptors – Shape Numbers.	20

Text Books:

- R.C.Gonzalez and R.E.Woods, "Digital Image Processing", Prentice Hall, 3rd Edition,2011.

Reference Books:

- BhabatoshChanda and D. DuttaMajumder, "Digital Image Processing and Analysis", PHI,2011.
- S. Sridhar , "Digital Image Processing", Oxford University Press,2011

Focus: This Course focuses on Employability under CO1,CO2,CO5.

Outcomes: After completion of course, student will be able to:

- CO1: Understand mathematical formulation of an image, its processing steps and relationship between image pixels.
- CO2: Apply Image enhancement using intensity transformations and spatial filtering.
- CO3: Analyze image enhancement for frequency domain using Fourier transform.
- CO4: Formulate region of interest through morphological operations.
- CO5:Evaluate strongly co-related regions obtained through Segmentation using discontinuity and homogeneity based segmentation techniques
- CO6: Describe an object of an image using Shape Number and Boundary descriptors.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PSO1,PSO3
CO2	PO3,PO5,PO11,PO12/PSO3,PSO4
CO3	PO1,PO2,PO3,PO7/PSO2,PSO3
CO4	PO1,PO2,PO4/PSO1,PSO2,PSO4

CO5	PO4,PO5,PO3/PSO1,PSO2,PSO3
CO6	PO9,PO10,PO11,PO12/PSO1,PSO2,PSO4

BCSE0131: DIGITAL IMAGE PROCESSING LAB

Objective: *The objective of this Lab is to develop hands-on experience to write programs using MATLAB/*Python *language for digital manipulation of images in both spatial and frequency domains.*

Credits: 01 **L–T–P-J: 0–0-2-0**

Module No.	Content	Lab Hours
I/II	• Basic commands to familiarize with MATLAB & perform the various Matrix operations. • Understanding image basic "image resize, image type conversion, extraction of color band, creating a synthesic image, pseudocolor image" • Perform various arithmetic operation (image addition, subtraction& complement) & logical operation (NOT, OR and XOR) on images • Perform various Image Enhancement operations: Image Negation function, Logarithmic Transformation, Power Law Transformation, Histogram Equalization, contrast stretching, plot histogram without using imhist function • Perform smoothing using linear (average filter) and order statistics filters (min, max & median) of varying sizes • Sharpen an image using Laplacian filter. • Perform various Fast Fourier transform (FFT) and frequency domain filtering on images using MATLAB. • Perform various Image Enhancement operation in frequency domain • Perform various Morphological operation dilation, erosion, internal & external boundary Extraction, Thinning,thickening of image &Perform Dilation, erosion, boundary Extraction without using direct function • Perform various thresholding segmentation (Simple, Multiple, and Adaptive thresholding) • Perform the various Edge Detection Operators (Ordinary, Roberts, Prewit, Sobeland Canny Operator) • Minor Application Assignment.	12*2=24

Reference Books:

- R.C. Gonzalez and R.E. Woods, "Digital Image Processing Using MATLAB", PHI, 2nd Edition,2010.
- Hands-On Image Processing with Python by SandipanDey, November 2018, Packt
- https://www.pyimagesearch.com/

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcomes: After studying the subject, the students will be able to:

- CO1: Implement digital image processing operations for image manipulation and Enhancement.
- CO2: Test the source code for Morphological and Segmentation algorithms.
- CO3: Apply image processing algorithms in real-life problems as Minor Application Assignment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO6,PO9/PSO1,PSO2
CO2	PO5,PO7,PO8,PO10/PSO1,PSO4
CO3	PO1,PO3,PO11,PO12/PSO3,PSO4

BCSE0102: COMPUTER GRAPHICS & MULTIMEDIA

Objective:

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Line clipping algorithms**: Cohen Sutherland line clipping algorithm, Liang Barsky Algorithms. Polygon clipping algorithms: Sutherland Hodgeman, Weiler Atherton algorithms. **2DTransformation:**Translation, Rotation, Scaling, Mirror Images, transformations about an arbitrary point. **3D- Transformation:** Translation, Rotation, Scaling, Rotation about an arbitrary axis, reflection about arbitrary planes. **Projection:** parallel and perspective projections; orthographic Projections, Axonometric, oblique, Multiple Views, Isometric Projection, Perspective Projections (one, two and three vanishing points). **Quadric surfaces**: spline representation, spline specification. Bezier curves, B-splines.	20
II	**Multimedia:** Multimedia Architecture, Multimedia File formats. **Compression** – lossy and lossless compression, **Text compression-** Run length encoding (RLE), Shannon- Fano Algorithm, Huffman Algorithm. Dictionary Methods-LZW Algorithms. **Image Compression-** JPEG, MPEG. **Audio Compression**; WAVE, MPEG-1/2 Audio Layers. MIDI-File format, MIDI and digital audio. **Illumination and Color Models:** basic illumination models- Ambient light, Diffuse and Specular, Shading- Flat, Gouraud, Phong. C**olor Models:** RGB color model, YIQ color model, CMY color models. **Graphics Standards:** GKS, PHIGS.	20

Text Books:

- D.Hearn and M.P.Baker, Computer Graphics, PHI, 1996.

Reference Books:

- W.K. Gilloi , Interactive Computer Graphics, PHI.
- D.F. Rogers, Procedural Elements for Computer Graphics, TMH .
- J.D. Foley and A.D. Van, Fundamentals of Interactive Computer Graphic
- Rogers and Adam, Mathematical Elements for Computer Graphics, TMH
- R.Steinmetz and K. Nahstedt, Multimedia: Computing, Communications and Applications PHI,PTR,1995
- Salomon, D., Motta, G. Handbook of Data Compression , Springer.2010.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: At the end of the course, students will be able to understand:

- CO1: Understand and demonstration of basic concepts of 2D and 3D Geometrical Transformations.
- CO2: Understand the concept of vewing, viewport, window and curves and surfaces.
- CO3: Implement of clipping on different objects as line, point and polygon.
- CO4: Identify the projections of a given object in 2D environment.
- CO5: Understand the concepts of Illumination and Shading.
- CO6: Discuss and solve simple problems in the basic representation and handling of multimedia data (images, audio and animation).
- CO7: Demonstrate and implementation of compression techniques of Text, image, Audio, video.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1,PO3/PSO1,PSO3
CO3	PO1,PO5/PSO1
CO4	PO1,PO5/PSO1,PSO2
CO5	PO1,PO3/PSO1,PSO3
CO6	PO1,PO6/PSO1,PSO2
CO7	PO1,PO10/PSO1,PSO4

BCSE0103: SOFT COMPUTING

Objective: *Students will get an insight of the intelligent computational approaches.Providing students, the mathematical background to carry out optimization.*

Credits: 03 **L–T–P-J: 3–0–0-**

Module No.	Content	Teaching Hours
I.	**Neural Networks:** Introduction to Soft Computing & Neural Computing, Fundamentals of Artificial Neural Network(ANN), Models of ANN, ANN models: Rosenblatt's Perception, McCulloch & Pitts Model, Single Layer Perceptron, Learning Methods in Perceptron, Linearly Separable Task and XOR Problem, Multi-Layer Perceptron, Back Propagation Learning Algorithm, Associative Memory: Hopfield network, Auto Associative Memory, Bidirectional Hetro-Associative Memory, ADALINE, MADALINE Network, Applications of Neural Network. **Fuzzy Logic:** Introduction to Fuzzy Sets & Crisp Sets, Fuzzy Membership and Fuzzy Operations, Properties of Fuzzy Sets- Linguistic Hedges, Fuzzy Logic – T-norms and other aggregation operators, Crisp Relations.	20
II.	**Fuzzy Logic:** Fuzzy Relations, Fuzzy System, Crisp Logic, Propositional Logic and its Laws, Inference in Propositional Logic, Fuzzy Logic, Inference in Fuzzy Logic (GMP and GMT), Fuzzy Rule Based System, Fuzzyfication & Defuzzification, Applications of Fuzzy Logic. **Genetic Algorithm(GA):**Introduction to GA, Search optimization Method, Evolutionary Algorithm Working Principle, Biological Background of GA, Working Principles of GA, Encoding(Binary, Value, Permutation, Tree), Operators of GA(Random Population, Reproduction or Selection), Crossover and Mutation, Basics of Genetic Algorithm with Examples, Introduction to Genetic programming	20

Text Books:

- S. Rajsekaran& G.A. VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", 4th Edition, Prentice Hall of India,2003.

Reference Books:

- Timothy J Ross ,"Fuzzy Logic with Engineering Applications", 3rd Edition, John Wiley and Sons,2016.
- David E. Goldberg ,"Genetic Algorithm in Search Optimization and Machine Learning "Adission-Wesley,2009.
- Karray, "Soft Computing and Intelligent Systems Design: Theory, Tools and Applications", 1st Edition, Pearson Education,2009.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After completion of course, student will be able to:

- CO1: Understand basics of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
- CO2: Demonstrate the ability to develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.
- CO3: Understand about the fundamental theory and concepts of neural networks, neuro modeling, several neural networks paradigms and its applications.
- CO4: Design and implement the concepts of knowledge using fuzzy inference systems and other machine intelligence applications.
- CO5: Identify an evolutionary computing paradigm known as genetic algorithms and its applications to engineering optimization problems.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PSO3
CO2	PO2,PO3, PO4/PSO2
CO3	PO2,PO3, PO5/PSO4
CO4	PO1,PO12/PSO4
CO5	PO2,PO5,PO12/PSO4

BCSE0132: SOFT COMPUTING LAB

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I/II	• Plot different types of activation functions. • Program to create a perceptron network using command 'newp' • Program for single perceptron • To implement AND function using ADALINE with bipolar inputs and outputs. • To construct and test auto associative network for input vector using HEBB rule • Create a multilayer perceptron network and write a Program for Backpropagation network. • Program for fuzzy set with properties and operations • Program for composition on Fuzzy and Crisp relations • Program to find a relation using Max-Min Composition, enter the two vectors whose relation is to be find • Method of Defuzzification • Write a program for design an inference system using membership function • Write a program for all types of crossover methods. • Write a program for complete Genetic Algorithm cycle.	12*2=24

Text Books:

- N P Padhy, "Soft Computing: With MATLAB Programming", Oxford Publication,2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcomes: After completion of Lab, student will be able to:

- CO1: Understand about the existing software tools to solve real problems using a soft computing approach.
- CO2: Design and implement the concepts of knowledge using fuzzy inference systems and other machine intelligence applications.
- CO3: Implement the concepts of crossover and genetic algorithms.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/PSO1
CO2	PO2,PO12/PSO2
CO3	PO3,PO4/PSO3

BCSE0104: ARTIFICIAL INTELLIGENCE

Objective: *The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to Artificial Intelligence, Foundations of Artificial Intelligence, Applications of Artificial Intelligence, Turing Test. **Introduction to Intelligent Agents:** Agents and Environment, Concept of rationality. Nature of environments, Knowledge based Agents, Structure of Intelligent Agents. **Problem solving:** Searching for solutions, Uninformed search strategies, Informed search strategies, Heuristic versus Solution Guaranteed Algorithm, Hill Climbing, Simulated Annealing, Best First Search (A*), Problem Reduction (AO*). **Knowledge & Reasoning:** Propositional logic, First order predicate logic, Horn Clause, Inference in First order logic, Unification, Forward& Backward chaining, Resolution, Probabilistic reasoning, Bayesian Networks.	22
II	**Knowledge Representation:** Semantic nets,Partition net, Minskey Frames, Case Grammar Theory, Transition Nets , Augmented Transition Net **Game Playing:** Adversarial Search, Search for games, Alpha - Beta pruning, Min-Max algorithm, Example of Games. **Introduction to Expert System:** Rule based System, Architecture of expert system, description of DENDRAL and MYCIN, Domain exploration, Meta Knowledge, Fuzzy Expert System, Self-Explaining System. **Introduction to Machine Learning:** Introduction, Supervised and unsupervised learning, Decision trees, Introduction to Statistical learning models, Reinforcement learning.	22

Text Book:

- S. Russell and P. Norvig, "Artificial Intelligence: AModern Approach", 3rdEditionPrentice Hall

Reference Books:

- Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill
- Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India,
- E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education

Focus: This Course focuses on Employability under CO1,CO3,CO5.
Outcomes: After completion of Lab, student will be able to:

- CO1: Apply the concepts of artificial intelligence.
- CO2: Formulate the complex problem using heuristic methods.
- CO3: Apply and design knowledge base.
- CO4: Formulate probability based AI Systems.
- CO5: Applydecision tree and statistical learning.
- CO6: Formulate models for Expert Systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3,PSO4
CO2	PO2/PSO3
CO3	PO1,PO3/PSO2,PSO3
CO4	PO2/PSO2,PSO3

CO5	PO1 /PSO3
CO6	PO2/PSO3,PSO4

BCSE0105: MACHINE LEARNING

Objective:

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Machine Learning basics, Hypothesis space and inductive bias, training and test set, and cross-validation. **Introduction to Statistical Learning:** Bayesian Method. **Machine Learning:** Supervised (Regression, Classification) vs. Unsupervised (Clustering) Learning. **Data Preprocessing:** Imputation, Outlier management, One hot encoding, Dimensionality Reduction- feature extraction, Principal Component Analysis (PCA), Singular Value Decomposition **Supervised Learning:** Regression- Linear regression, Polynomial regression, Classification- Logistic regression, k-nearest neighbor classifier,	20
II	**Supervised Learning:** Decision tree classifier, Naïve Bayes classifier Support Vector Machine (SVM)Classifier, **Unsupervised Learning:** k-means clustering, Hierarchical clustering **Underfitting vs Overfitting:** Regularization and Bias/Variance. **Ensemble methods:** Bagging, Boosting, Improving classification with Ada-Boost algorithm.	20

Text Book:

- Tom M. Mitchell, Machine Learning. Tata McGraw-Hill Education, 2013.
- Alpaydin, E. . Introduction to machine learning. MIT press, 2009.

Reference Books:

- Harrington, P. , " Machine learning in action", Shelter Island, NY: Manning Publications Co, 2012.
- Bishop, C. M. . Pattern recognition and machine learning (information science and statistics) springer-verlag new york. Inc. Secaucus, NJ, USA. 2006

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO6.
Outcomes: After completion of Lab, student will be able to:

- CO1: Apply the basic concepts of machine learning.
- CO2: Apply the concepts of regression and re-sampling methods.
- CO3: Design supervised and re-enforcement learning based solution.
- CO4: Apply the ensemble methods for improving classification.
- CO5: Identify the ways of feature extraction, reduction and selection.
- CO6: Design the applications of machine learning algorithms.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3,PSO4
CO2	PO1,PO2/PSO1,PSO3
CO3	PO1,PO3,PO5/PSO1,PSO3
CO4	PO1 /PSO1
CO5	PO2/PSO3
CO6	PO1,PO2,PO3/PSO1,PSO2,PSO4

BCSE0106: MACHINE LEARNING AND ITS APPLICATIONS

Objective:

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Machine Learning basics, Applications, Type of Learning Algorithm **Hypothesis space and inductive bias**: Concept-Learning, Hypotheses Representation,Find-S Algorithm **Machine Learning:Training, Testing, Evaluation:** Cross-validation, Confusion Matrix, Precision, Recall, F1-score, ROC curve, Overfitting, Bias, Variance Trade off **Supervised Learning:** Regression- Linear regression, Polynomial regression, Gradient Descent Algorithm **Data Preprocessing:** Imputation, Outlier management, One hot encoding, Feature selection, Filter and Wrapper approach **Supervised Learning:** Classification- Logistic regression, k-nearest neighbor classifier, Decision tree classifier, Naïve Bayes classifier,	20
II	**Supervised Learning:**Support vector machine classifier **Feature Extraction:** Principal Component Analysis (PCA) **Unsupervised Learning:** k-means clustering, Hierarchical clustering **Ensemble methods:** Bagging, Boosting, Improving classification with Random forest, Ada-Boost algorithm. **Artificial Neural Network -** Introduction, Model Representation, Gradient Descent, Stochastic Gradient Descent, Multilayer Perceptron, Multiclass Representation, Backpropagation Algorithm. **Deep Learning:** Introduction, Convolutional neural network and Recurrent neural network	20

Text Book:

- Tom M. Mitchell, "Machine Learning". Tata McGraw-Hill Education, 2013.
- Alpaydin, E. , " Introduction to machine learning". MIT press, 2009.

Reference Books:

- Harrington, P., ." Machine learning in action". Shelter Islan", NY: Manning Publications Co, 2012.
- Bishop, C. M. . Pattern recognition and machine learning (information science and statistics) springer-verlag new york. Inc. Secaucus, NJ, USA, 2006.

Focus: This Course focuses on Employability under CO1,CO2,CO4
Outcomes: After completion of Lab, student will be able to:

- CO1: Apply the basic concepts of machine learning.
- CO2: Analyze the concepts of regression and re-sampling methods.
- CO3: Design supervised and re-enforcement learning based solutions.
- CO4: Apply the ensemble methods for improving classification.
- CO5: Identify the ways of feature extraction, reduction and selection.
- CO6: Design the applications of machine learning algorithms.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3,PSO4
CO2	PO1,PO2/PSO1,PSO3
CO3	PO1,PO3,PO5/PSO1,PSO3
CO4	PO1 /PSO1
CO5	PO2/PSO3
CO6	PO1,PO2,PO3/PSO1,PSO2,PSO4

BCSE0133: MACHINE LEARNING LAB

Credits: 01 **L–T–P-J: 0–0-2-0**

Objective:

S.No	PROGRAM
1	Estimate parameters of a model based on Linear Regression method using a given set of training data set.
2	Estimate parameters of a model based on maximum likelihood estimation method using a given set of training data set.
3	Compute weights of ANN based on back propagation method using a given training dataset.
4	Compute probability of a person to be diabetic based on a given dataset of diabetic persons using Naïve Bayesian classifier.
5	Classify a person as male or female based on a given dataset using naïve Bayesian Classifier, and calculate accuracy, precision, and recall for your data set.
6	Write a program to implement *k*-Nearest Neighbour method to classify the iris data set. Print both correct and wrong predictions. Use Java/Python ML library classes
7	Predicts whether the bank should approve the loan of an applicant, based on his profile using Ensemble learning method.
8	Apply Ensemble learning to cluster a set of data stored in a .CSV file. Use the same dataset for clustering using *k*-Means method. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
9	The stock prediction data is used to predict, whether the stock will go up or down. Perform the task of feature selection with the help of wrapper method.
10	Identify principal components of Big Mart sales data using Principal component analysis (PCA). Also plot the result of PCA, and give inferences.

Focus: This Course focuses on Employability under CO1,CO2,CO4.
Outcomes: After studying the subject, the students will be able to:

- CO1: Applythe machine learning algorithms in the area of text, audio and image processing.
- CO2: Apply classification algorithms to design complex problems.
- CO3: Design solution to societal issues using machine learning algorithms.
- CO4: Analyze the view problem in the perspective of machine learning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO/PSO
CO1	PO3,PO5/PSO4
CO2	PO1,PO5/PSO1,PSO3,PSO4
CO3	PO3 /PSO1,PSO2,PSO4
CO4	PO2,PO3/PSO1,PSO2,PSO4

BCSE0141: MACHINE LEARNING PROJECT

Credits: 02 **L–T–P-J: 0–0–0-0**

1. Iris Flowers Classification ML Project: Learn about Supervised Machine Learning Algorithms

Objective: The goal of this machine learning project is to classify the flowers into among the three species – virginica, setosa, or versicolor based on length and width of petals and sepals.

2. BigMart Sales Prediction ML Project: Learn about Unsupervised Machine Learning Algorithms

Objective: The goal of the BigMart sales prediction ML project is to build a regression model to predict the sales of each of 1559 products for the following year in each of the 10 different BigMart outlets.

3. Social Media Sentiment Analysis using Twitter Dataset

Objective: Working with the twitter dataset will help you understand the challenges associated with social media data mining and also learn about classifiers in depth.

4. Sales Forecasting using Walmart Dataset

Objective: The goal of this machine learning project is to forecast sales for each department in each outlet to help them make better data driven decisions for channel optimization and inventory planning.

5. Learn to build Recommender Systems with MovieLens Dataset

Objective: The goal of this machine learning project is to start working with this dataset by building a world-cloud visualization of movie titles to build a movie recommender system.

6. Stock Prices Predictor

Objective: Stock prices predictor is a system that learns about the performance of a company and predicts future stock prices.

7. Boston Housing Price Prediction ML Project

Objective: The goal of this machine learning project is to predict the selling price of a new home by applying basic machine learning concepts on the housing prices data.

8. MNIST Handwritten Digit Classification

Objective: The goal of this machine learning project is study, analyze and recognize elements in the images.

9. Human Activity Recognition using Smartphone Dataset

Objective: The goal of this machine learning project is to build a classification model that can precisely identify human fitness activities. Working on this machine learning project will help you understand how to solve multi-classification problems.

10. Use classification and clustering techniques to deal with the Turkiye Student Evaluation Data Set

Objective: This dataset is based on an evaluation form filled out by students for different courses. It has different attributes including attendance, difficulty, score for each evaluation question, among others. This is an unsupervised learning problem.

11. Predict height and weight from Heights and Weights dataset.

Objective: The goal of this project is to learn the concept of Regression.

12. Text Mining Data Set

Objective: The goal of this project is classify the documents according to their labels.

13. Predict the income class of any country population

Objective: The goal of this project is to work with imbalanced classification problem.

14. Classify the type of sound from the audio.

Objective: The goal of this project is to introduce the student to audio processing in the usual classification scenario.

SYLLABUS

OF

PROGRAM ELECTIVE

BOUQUET: ADVANCED DATA PROCESSING

DEPARTMENT OF COMPUTER ENGINEERING & APPLICATIONS

Under

Choice Based Credit System (CBCS)

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
Bouquet: Advanced Data Processing									
Theory									
1.	BCSE0151	Advanced Concepts in Database Systems	3	0	0	0	3	3	DBMS
2.	BCSE0152	Data Mining and Warehousing	3	0	0	0	3	3	DBMS
3.	BCSE0153	Business Intelligence	3	0	0	0	3	3	DMW
4.	BCSE0154	Information Retrieval System	3	0	0	0	3	3	DATA STRUCTURE
5.	BCSE0155	Distributed and Parallel Databases	3	0	0	0	3	3	DBMS
6.	BCSE0156	Natural Language Processing	3	0	0	0	3	3	TAFL/Compiler Design
7.	BCSE0157	Introduction to Big Data Analytics	3	0	0	0	3	3	DBMS
8.	BCSE0158	Big Data Analytics	3	0	0	0	3	3	
Labs									
1.	BCSE0181	Data Mining and Warehousing Lab	0	0	2	0	1	2	
2.	BCSE0182	Business Intelligence Lab	0	0	2	0	1	2	
3.	BCSE0183	Big Data Analytics Lab	0	0	2	0	1	2	
Projects									
1.	BCSE0191	Business Intelligence Project	0	0	0	-	2	-	
2.	BCSE0192	Big Data Analytics Project	0	0	0	-	2	-	Programming

BCSE 0151: ADVANCED CONCEPTS IN DATABASE SYSTEMS

Objective: *This course aims to give students in depth information about query processing and optimization, advanced query processing techniques, and advanced databases.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Query Processing and Optimization:** Concept of High-level Query Processing, Algorithms for Executing Query Operations. Heuristics for Query Optimizations, Estimations of Query Processing Cost, Query Evaluation Plans, Pipelined Evaluations, Query Processing using Join, Group by and Sub Queries. **Advanced Query Processing:** Advanced Query Processing using Records, Cursors, Stored Procedures. Advanced PL/SQL Functions: Parameters in Procedure and Functions, Exception Handling, Types of PL/SQL Triggers: Row level Triggers, Statement level Triggers, Cyclic Cascading in Triggers.	20
II	**Enhanced Data Model for Advanced Applications:** Introduction to Temporal Database Concepts, Spatial and Multimedia Databases, Active Database System, Deductive Databases, Main Memory Database, And Evolutionary Database. **Introduction to Expert Database and Fuzzy Database System:** Expert Databases - Use of Rules of Deduction in Databases, Recursive Rules. Fuzzy Databases – Fuzzy Set & Fuzzy Logic, Use of Fuzzy Techniques to Define Inexact and Incomplete Databases.	20

Text Books:

- Elmasri, Navathe, “Fundamentals of Database Systems”, 7thEdition, Pearson,2016.

Reference Books:

- Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Wisdom , “Database Systems: The Complete Book",2ND Edition, Pearson,2008.
- Korth, Silbertz, Sudarshan, “Database Concepts”, 6thEdition, McGraw Hill,2011.
- Ramakrishnan, Gehrke, “Database Management System”, 3rd.Edition, McGraw Hill,2007.

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcomes: After completion of course, student will be able to:

- CO 1: Design high-level query using Join, Group by and sub queries.
- CO 2: Understand query optimization and query evaluation using different techniques.
- CO 3: Implement advanced queries as series of primitive operations.
- CO 4: Implement PL/SQL triggers in different applications.
- CO 5: Understand functioning of advance databases.
- CO 6: Apply expert databases in designing fuzzy logic based applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3/PSO2
CO2	PO4/PSO4
CO3	PO1/PSO1
CO4	PO2,PO3/PSO4
CO5	PO5/PSO1
CO6	PO3/PSO4

BCSE 0152: DATA MINING & WAREHOUSING

Credits: 03 **L–T–P-J: 3–0–0-0**

Objective: *The Objective of this course is to introduce the basic concepts of Data Warehouse and Data Mining techniques.*

Module No.	Content	Teaching Hours
I	**Data Warehousing**: Overview, Difference between Database System and Data Warehouse, Multi-dimensional Data Model: Concept Hierarchy, Three-Tier Architecture, Meta Repository, Data Warehouse & OLAP Technology, Types of OLAP Servers. Data Cubes Computations & Data Generalization. **Data Pre Processing**: Data Cleaning, Data Integration and Data Transformation, Data Reduction **Mapping the Data Warehouse** to a Multiprocessor Architecture, Multi Dimensional Data Model. **Introduction**: Basics of Data Mining, Issues and Applications of Data Mining Techniques. Mining frequent Patterns: Basic Concepts of Association Rules Mining, Apriori Algorithm, FP-Growth. Multilevel Association Rules, Multi-Dimensional Association Rules.	13
II	**Classification and Predictions**: Classification & Prediction, Issues Regarding Classification and Prediction, Decision Tree, Bayesian Classification, Back Propagation, Neural Network, Nearest Neighbour Classifiers, Support Vector Machines, Prediction. **Data Mining Cluster Analysis**: Data Types in Cluster Analysis, Categories of Clustering Methods, Partitioning Methods. **Hierarchical Clustering**- CURE and Chameleon. **Density Based Methods**-DBSCAN, OPTICS. Grid Based Methods STING, CLIQUE. **Model Based Method** –Statistical Approach, Outlier Analysis, Mining Multimedia Data, Text Mining, Web Data Mining, Spatial Data Mining, Temporal Data Mining, Data Visualization.	13

Text Books:

- Jiawei Han, MichelineKamber," Data Mining Concepts& Techniques", 3rdEdition, Morgan Kauffmann,2013.

Reference Books:

- M. H. Dunham , "Data Mining: Introductory and Advanced Topics", 1st Edition, Pearson Education,2003.
- Sam Anahory, Dennis Murray , "Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems", 4th Edition, Pearson Education,2009.
- Pang-Ning Tan, Michael Steinbach, Vipin Kumar , "Introduction to Data Mining", 2ndEdition, Addison-Wesley,2006.
- Aggarwal, , "Data Mining: The Textbook", Springer,2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After the completion of this course, student will be able to:

- CO1: Understand and apply the concept of data warehouse and mining in real-life applications.
- CO2: Apply the principle algorithms used in modern machine learning.
- CO3: Apply the information theory and probability theory to get the basic theoretical results in Data Mining.
- CO4: Apply Data mining algorithms to real datasets, evaluate their performance and appreciate the practical issues involved.
- CO5: Implement clustering using various clustering methods on data set.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3,PO4/PSO1,PSO3
CO3	PO1 /PSO1
CO4	PO1 /PSO2
CO5	PO3/PSO2

BCSE0181: DATA MINING & WAREHOUSING LAB

Credits: 01 **L–T–P-J: 0–0–2-0**

Objective: *The Objective of this course is to implement and run the programme based on the basic concepts of Data Warehouse and Data Mining techniques*

Module No.	Content	Lab Hours
I/II	• Demonstration of pre-processing on different dataset • Demonstration of Association rule process on different dataset using apriori algorithm • Demonstration of classification rule process on different dataset using FP Tree algorithm • Demonstration of classification rule process on different dataset using id3 algorithm • Demonstration of classification rule process on different dataset using naïve bayes algorithm • Demonstration of clustering rule process on different dataset using simple k-means • Demonstration of clustering rule process on different dataset using simple k-mediods • Demonstration of clustering rule process on different dataset using simple k-mode. • Demonstration of clustering rule process on different dataset using DBSCAN. • Demonstration of clustering rule process on different dataset using simple Hieratical based algorithm. • Implementation of K-NN Algorithms on different data sets. • Implementation of Sequential pattern SPADE algorithm on sequence data set. • Implementation of Sequential pattern GSP algorithm on sequence data set. • Implementation of SVM on a two dimensional data set. • Demonstration of Decision Tree on Weka Tool.	24

Text Books:

- Toby Segaran, Programming Collective Intelligence Building Smart Web 2.0 Applications, O'Reilly Media,2015.

Reference Books:

- Mark Hall, Eibe Frank, Geoffrey Holmes, Bernhard Pfahringer, Peter Reutemann, and Ian H. Witten (2009). The WEKA Data Mining Software: An Update. SIGKDD Explorations, Volume 11, Issue 1.
- https://www.cs.waikato.ac.nz/ml/weka/Witten_et_al_2016_appendix.pdf

Focus: This Course focuses on Employability under CO1,CO2.

Outcomes: After completion of this course students will be able to:

- CO1: Implement the clustering technique like DBSCAN, K-NN, K Mean.
- CO2: Implement SVM on two dimensional data set.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs

CO1	PO3/PSO3
CO2	PO1,PO3/PSO2

BCSE0153: BUSINESS INTELLIGENCE

Objective: *The objective of this course is for the students to achieve a profound understanding of Business Intelligence (BI) systems in terms of its tools, current practices and impacts.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Business Intelligence:** BI Definitions & Concepts, BI Framework, Data Warehousing Concepts and Its Role in BI; BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities, Business Applications of BI, BI Best Practices. Effective and timely decisions – Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system – Ethics and business intelligence. **Basics of Data Integration:** Concepts of Data Integration, Needs and Advantages of using Data Integration, Introduction to Common Data Integration Approaches; Meta Data - Types and Sources, Introduction to Data Quality	20
II	Data Profiling Concepts and Applications, Introduction to ETL using Kettle. Marketing models – Logistic and Production models – Case studies. **Efficiency Measures and Metrics:** Efficiency measures – The CCR model: Definition of target objectives- Peer groups – Identification of good operating practices; cross efficiency analysis – virtual inputs and outputs – Other models. Introduction to Business Metrics and KPIS, Creating Cubes using Microsoft Excel. **Basics of Enterprise Reporting:** A Typical Enterprise, Malcolm Bridge - Quality Performance Framework, Balanced Scorecard, Enterprise Dashboard, Balanced Scorecard vs. Enterprise Dashboard, Enterprise Reporting using MS Access / MS Excel, Best Practices in the Design of Enterprise Dashboards.	20

Text Books:

- RN Prasad and Seema Acharya , “Fundamentals of Business Analytics”, Wiley India, 2nd Edition,2018.

Reference Books:

- U Dinesh Kumar , “Business Analytics: The Science of Data - Driven Decision Making”, Wiley India, 1st Edition,2017.
- David Loshin, “Business Intelligence”, 2nd Edition, Elsevier Science & Technology,2012.
- Mike Biere, “Business Intelligence for the Enterprise”, Pearson,2010.
- IBM , “An Introduction to Building Data Warehouse”, Prentice Hall of India,2004.
- Larissa Terpeluk Moss &ShakuAtre, “Business Intelligence Roadmap”, Pearson,2003

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: At the end of this course, student will be able to

- CO1: Identify the major frameworks of computerized decision support: decision support systems (DSS), data analytics and business intelligence (BI).
- CO2: Explain the foundations, definitions, and capabilities of DSS, data analytics and BI.
- CO3: Design tested and effective advanced analytics models and simulations for decision making.
- CO4: Understand the methodology of engineering legacy databases for business intelligence to derive business rules for decision support systems.
- CO5: Articulate assumptions, analyses, and interpretations of data in an oral formatApply big data technologies in business intelligence using geospatial data, location-based analytics, social networking, Web 2.0, reality mining, and cloud computing.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/PSO1
CO2	PO1,PO2/PSO3
CO3	PO1/PSO1,PSO3
CO4	PO3,PO6/PSO1,PSO4
CO5	PO2,PO3/PSO2

BCSE0182: BUSINESS INTELLIGENCE LAB

Objective: *This course introduces students to Business Intelligence, Students will learn to create multiple reports and analyze data using various methods and generate Business reports. Student will also learn data representation in dimensional Modeling*

Credits: 01 **L-T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I& II	**Introduction to Cognos Studio(Framework Manager, Report Studio, Query Studio)** • Overview of BI Tool-Cognos Report Studio • Installation of Cognos with IBM DB2 • Authoring Reports **Generation of Sample Reports** • List, Crosstab and Charts Reports • Grouping and Summarizing Data **Various Operation on Reports** • Filtering on Reports • Sorting and calculation on Reports • Adding Prompt in Reports • Creation of Miscellaneous Reports • Scenario/ Objective Based Reports	24

Reference Books:

- Paul Teetor. R Cookbook: Proven recipes for data analysis, statistics, and graphics. O'Reilly Media, Inc.,2011.
- Norman Matloff. Theart of R programming: A tour of statistical software design. No Starch Press, 2011.
- Winston Chang. R graphics cookbook. O'Reilly Media, Inc., 2012.
- Hadley Wickham and Garrett Grolemund. R for data science. 2016.
- Phil Spector. Data manipulation with R. Springer Science& Business Media, 2008.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcomes: At the end of the course, student is able to:

- CO1: Apply R-Studio, read R documentation, and write R scripts.
- CO2: Analyse the data using data analytics latest tools based on HDFS like Pig, Hive.
- CO3: Implement the aggregation projection on data set using Cassandra, MongoDB.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO4,PO5/PSO2
CO2	PO2,PO3/PSO4
CO3	PO1,PO2/PSO1

BCSE0154 : INFORMATION RETRIEVAL SYSTEMS

Objective: *This course aims to give students an understanding of the fundamental techniques for hyper-media architectures, design and usability, document management and retrieval, meta data management, and searching the web.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to IR:** IR Concepts, Boolean Retrievals- An Example Information Retrieval Problem, A First Take at Building an Inverted Index, Processing Boolean Queries. **The Term Vocabulary and Postings Lists:** Document Delineation and Character Sequence Decoding, Determining the Vocabulary of Terms. **Dictionaries and Tolerant Retrieval:** Search Structures for Dictionaries, Wildcard Queries, Spelling Correction, Phonetic Correction. **Index Construction:** Hardware Basics Blocked Sort-Based Indexing.Scoring, Term Weighting and the Vector Space Model: Parametric and Zone Indexes, Term Frequency and Weighting, The Vector Space Model for Scoring.	22
II	**Evaluation in Information Retrieval:** Information Retrieval System Evaluation, Standard Test Collections, Evaluation of Unranked Retrieval Sets, Evaluation of Ranked Retrieval Results. **XML Retrieval:** Basic XML Concepts, Challenges in XML Retrieval, A Vector Space Model for XML Retrieval, Evaluation of XML Retrieval, Text-Centric vs. Data-Centric XML Retrieval. **Web Search Basics:** Web Characteristics, Advertising as the Economic Model, The Search User Experience, Index Size and Estimation, Near-Duplicates and Shingling. **Web Crawling and Indexes:** Overview, Crawling, Distributing Indexes, Connectivity Servers. **Link Analysis:** The Web as a Graph, Page Rank, Hubs and Authorities.	20

Textbook:

- Christopher D. Manning, Prabhakar Raghavan and HinrichSchütze , "Introduction to Information Retrieval", Cambridge University Press,2009.

Reference Books:

- Ricardo Baeza-Yate, Berthier Ribeiro-Neto,"Modern Information Retrieval",2nd Edition, Addison Wesley,2011.
- SoumenChakrabarti, "Mining the Web: discovering knowledge from hypertext data", 2nd Edition, Morgan Kaufmann,2002
- David A. Grossman, Ophir Frieder , "Information Retrieval: Algorithms, and Heuristics",2nd Edition, Springer,2004.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After successful completion of this course, students should be able to:

- CO1: Apply different information retrieval techniques in real life application.
- CO2: Analyze indexing and pre-processing of textual documents for IR system.
- CO3: Apply IR principles into Spelling Correction, Phonetic Correction.
- CO4: Analyze performance of retrieval systems.
- CO5: Apply IR techniques to XML Retrieval.
- CO6: Develop retrieval systems for web search tasks.
- CO7: Demonstrate similarity computation for document.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO3
CO2	PO2,PO4/PSO4
CO3	PO1,PO3,PO4/PSO4
CO4	PO3,PO4/PSO1,PSO4
CO5	PO1,PO2,PO5/PSO1
CO6	PO3,PO5 /PSO1,PSO4
CO7	PO2,PO3,PO5/PSO2

BCSE0155: DISTRIBUTED AND PARALLEL DATABASE

Objective: *The course introduces the types of parallelism in database systems, architecture of parallel and distributed database systems; parallel query processing; data partitioning.*

Credits: 03 **L-T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to Databases, Overview of Relational DBMS, Relational Database concepts, Normalization. **Distributed Database:** Introduction, Comparison of Distributed and CentralizedDatabaseSystems,DistributedDatabaseArchitecture,Distributed DataBaseDesign,TypesofDataFragmentations,FragmentationandAllocation of Fragments, Distributed Catalog Management. **Transactions Management in Distributed Database:** Properties and Goals of Transaction Management, Distributed Transactions, Two Phase Commit Protocol, Recovery Mechanism in case of Transaction Failures, Log Based Recovery, Communication and Site Failures.	20
II	**Concurrency Control in Distributed Database:** Serializability, Locking and Timestamp Based Concurrency Control Approach in Distributed Databases. Optimistic Concurrency Control Approach, Introduction to Distributed Deadlocks, Local and Global Wait-For-Graphs, Deadlock Detection and Prevention of Deadlocks. **Parallel Database:** Database Server Approach, Parallel Architectures, Parallel DBMS Techniques- Data Placement, Query Parallelism, Parallel Database Processing, Parallel Query Optimization; Parallel Execution Problems- Initialization, Interferences and Convoy Effect, Load Balancing, Parallel Execution for Hierarchical Architecture – Basic Concept, Load Balancing Strategy, Performance Evaluation.	20

Text Books:

- M. Tamer Oezsu, Patrick Valduriez. "Principles of Distributed DatabaseSystems",2nd Edition, Prentice Hall,2011.

Reference Books:

- Elmasri, Navathe, "FundamentalsofDatabaseSystems",5th Edition, Pearson,2011.
- Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, ,"Database Systems: The CompleteBook",2nd Edition, Pearson,2008.
- Philip A. Bernstein, VassosHadzilacos, Nathan Goodman , "Concurrency Control and Recovery in Database Systems",Addison-Wesley.1987.
- Jim Gray, Andreas Reuter,"Transaction Processing: Concepts and Techniques",Morgan Kaufmann,1993.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: At the end of the course, student will able to:

- CO1: Understand the concepts of distributed database and its structures.
- CO2: Apply queries for effective, noiseless data retrieval in distributed database environment.
- CO3: Implement various concurrency control approaches to ensure recovery of Database.
- CO4: Apply primitive operations concurrently.
- CO5: Understand parallel computing environments, their implications, cost benefits and services.
- CO6: Apply design techniques, middleware and development tools for tuning an application environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO5/PSO1
CO2	PO5/PSO4
CO3	PO5/PSO4
CO4	PO2/PSO4
CO5	PO1/PSO1
CO6	PO3/PSO2, PSO1

BSCE0156: NATURAL LANGUAGE PROCESSING

Objective: *The objective of this course is to introduce to the students the leading trends and system in natural language processing and make them understand the concepts of morphology, syntax, semantics and pragmatics of the language.*

Credits: 03 **L-T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	Introduction to Natural Language Understanding: The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural Language Understanding Systems, Linguistic Background: An outline of English syntax. Applications: Named entity recognition and relation extraction- IE using sequence labelling-Machine Translation (MT) - Basic issues in MT-Statistical translation-word alignment- phrase-based translation – Question Answering Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top-Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.	20
II	Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser. Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part of speech Tagging - Rule-Based Part of Speech Tagging - Markov Models - Hidden Markov Models, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.	20

Text Book:

1. James Allen, Natural Language Understanding, 2/e, Pearson Education, 2003

Reference Books:

1. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, NLP: A Paninian Perspective, Prentice Hall, New Delhi
2. D. Jurafsky, J. H. Martin, Speech and Language Processing, Pearson Education, 2002
3. L.M. Ivansca, S. C. Shapiro, Natural Language Processing and Language Representation
4. T. Winograd, Language as a Cognitive Process, Addison-Wesley

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO5.

Outcomes: After the completion of the course, the student will be able to:

- CO1: Understand the core tasks in NLP and its applications in real problems.
- CO2: Understand the human languages, be familiar with the most mainstream descriptive and theoretical frameworks for handling their properties.
- CO3: Understand the basics of knowledge representation, inference, and relations to the artificial intelligence.
- CO4: Understand the algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
- CO5: Understand the various translation strategies and techniques of maintaining balance among the three basic criteria of translation: accuracy, clarity and naturalness.

- CO6: Apply the Markov Models and it's variants to do the Part of Speech Tagging.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO2,PO5/PSO5
CO4	PO3/PSO3
CO5	PO1/PSO1
CO6	PO5/PSO4

BCSE0157: INTRODUCTION TO BIG DATA ANALYTICS

Objective:

Credits: 03 **L-T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Big Data Technology Landscape**: Types of Digital Data (Structured, Semi-Structured, Unstructured), Concept, importance and characteristics of data, Challenges with big data, Big data stack, Big Data 1.0, 2.0 and 3.0, Traditional BI vs. Big Data Environment, NoSQL Databases, NoSQL Vs. RDBMS, New SQL, Introduction to Data Science/Scientist **HADOOP 1.0:** Introducing Hadoop 1.0, Limitations of RDBMS, Hadoop Components, High Level Architecture of Hadoop, History of Hadoop, Special Features of Hadoop, Introduction to HDFS 1.0, Architecture, Daemons, working with HDFS Command, Introduction to Map-Reduce 1.0, Architecture, Daemons **HADOOP 2.0:** Introducing Hadoop 2.0, Limitations of 1.0, Introduction to HDFS 2.0, Architecture, Daemons, Introduction to Map-Reduce 2.0, YARN, Architecture, Daemons, Word Count Example using Java, Introduction to Hadoop 3.0, Difference among Hadoop1.0, Hadoop2.0, Hadoop3.0 **Introduction to Mongo DB**: RDBMS vs. MongoDB, JSON, Unique Key, Dynamic Queries, Sharding, Replication, MongoDB QL: Create, Drop Database and Collections, CRUD: Create, Insert, Find, Update, Delete, Map Reduce Programming, Aggregations	20
II	**Introduction to Cassandra DB**: Features of Cassandra, CQL Data Types, CQLSH: CRUD, Counter, TTL, List, Set, Map, Tracing, Import Export csv files **HADOOP Ecosystem and Flume:** Introduction to Hadoop Ecosystem, Sqoop, Zookeeper, Plug-in Components: Impala, Hue, Flume: Introduction, Application, Advantage, Features. **Introduction to HIVE:** Hive Architecture, Hive Data types, Hive Collection Types, Hive File Formats, Hive Query Language, Hive Partitions, Bucketing, Views, RCFile Implementation, Hive User Defined Function, SerDe, UDF **Introduction to Pig:** History and Anatomy of Pig, Pig on Hadoop, Use Case for Pig, Pig Primitive Data Types, Pig Latin Overview, Execution Modes of Pig, Field, Tuple, Bag, User Defined Function, Parameters in Pig, Piggy Bank, Word count example using Pig, Pig vs Hive, When to use Pig.	20

Text Book:

- Seema Acharya and SubhashiniChellappan, "Big Data and Analytics", 1st Edition, 2015, Wiley, India.
- Jure Leskovec, AnandRajaraman, Jeff Ullman, "Mining of Massive Datasets", 2nd Edition, 2014, Cambridge University Press.

Reference Books:

- Chuck Lam, "Hadoop in Action", 2nd Edition, 2014, Manning Publications.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO4.

Outcomes: At the end of the course, student will be able to

- CO 1: Understand the concepts and challenges of big data.
- CO 2: Apply existing technology to collect, manage, store, query, and analyze the big data.
- CO 3: Apply job scheduling of various applications and resource management using Hadoop and Yarn.
- CO 4: Apply the data summarization, query, and analysis of big data using pig and hive.
- CO 5: Design the regression model, cluster and decision tree of big data.
- CO 6: Experiment with hands-on experience in large-scale analytics tools to solve big data problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO5/PSO5
CO2	PO3/PSO4
CO3	PO3,PO5/PSO4
CO4	PO3,PO5/PSO4
CO5	PO3/PSO2
CO6	PO2/PSO4

BCSE0158: BIG DATA AND ANALYTICS

Objective: *Exposure to any object oriented programming language (such as Java) and basic operational knowledge of any RDBMS (such as MySQL)*

Credits: 03 **L-T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Big Data technology Landscape**: Types of Digital Data (Structured, Semi-Structured, Unstructured),Concept, importance and characteristics of data, Challenges with big data, Big data stack, Big Data 1.0, 2.0 and 3.0, Traditional BI vs. Big Data Environment, NoSQL Databases, NoSQL Vs. RDBMS, New SQL, Introduction to Data Science/Scientist. **HADOOP 1.0:** Introducing Hadoop 1.0, Limitations of RDBMS, Hadoop Components, High Level Architecture of Hadoop, History of Hadoop, Special Features of Hadoop, Introduction to HDFS 1.0, Architecture, Daemons, Working with HDFS Command, Introduction to Map-Reduce 1.0, Architecture, Daemons **HADOOP 2.0:** Introducing Hadoop 2.0, Limitations of 1.0, Introduction to HDFS 2.0, Architecture, Daemons, Introduction to Map-Reduce 2.0, YARN, Architecture, Daemons, Word Count Example using Java, Introduction to Hadoop 3.0, Difference among Hadoop1.0, Hadoop2.0, Hadoop3.0 **Apache Spark:** Introduction, Introduction to Spark & functional programming, Spark Concepts, RDD Fault Tolerance **Introduction to HBase:** What is HBase? HBase Architecture, HBase Components, Data model, HBase Storage Hierarchy, Cross-Datacenter Replication, Auto Sharding **Introduction to Cassandra DB:** Features of Cassandra, CQL Data Types, CQLSH: CRUD, Counter, TTL, List, Set, Map, Tracing, Import Export csv files	19
II	**HADOOP Ecosystem and Flume:** Introduction to Hadoop Ecosystem, Sqoop, Zookeeper, Plug-in Components: Impala, Hue, Flume: Introduction, Application, Advantage, Features. **Introduction to Mongo DB**: RDBMS vs. MongoDB, JSON, Unique Key, Dynamic Queries, Sharding, Replication, MongoDB QL: Create, Drop Database and Collections, CRUD: Create, Insert, Find, Update, Delete, Map Reduce Programming, Aggregations **Introduction to HIVE:** Hive Architecture, Hive Data types, Hive Collection Types, Hive File Formats, Hive Query Language, Hive Partitions, Bucketing, Views, RCFile Implementation, Hive User Defined Function, SerDe, UDF **Introduction to Pig:** History and Anatomy of Pig, Pig on Hadoop, Use Case for Pig, Pig Primitive Data Types, Pig Latin Overview, Execution Modes of Pig, Field, Tuple, Bag, User Defined Function, Parameters in Pig, Piggy Bank, Word count example using Pig, Pig vs Hive, when to use Pig. **Machine Learning:** Linear Regression, Logistic Regression, Association Rule	19

Text Book:

- Seema Acharya and SubhashiniChellappan, "Big Data and Analytics", 1st Edition, 2015, Wiley, India.
- Jure Leskovec, AnandRajaraman, Jeff Ullman, "Mining of Massive Datasets", 2nd Edition, 2014, Cambridge University Press.

Reference Books:

- Chuck Lam, "Hadoop in Action", 2nd Edition, 2014, Manning Publications.

Focus: This Course focuses on Employability under CO1, CO2, CO3,CO5.

Outcomes: At the end of the course, student will be able to

- CO 1: Understand the concepts and challenges of big data.
- CO 2: Apply existing technology to collect, manage, store, query, and analyze the big data.
- CO 3: Apply job scheduling of various applications and resource management using Hadoop and Yarn.
- CO 4: Apply the data summarization, query, and analysis of big data using pig and hive.
- CO 5: Design the regression model, cluster and decision tree of big data.
- CO 6: Experiment with hands-on experience in large-scale analytics tools to solve big data problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO3/PSO4
CO3	PO3,PO5/PSO4
CO4	PO3,PO5/PSO4
CO5	PO3/PSO2
CO6	PO2/PSO4

BCSE0183: BIG DATA AND ANALYTICS LAB

Objective: *This course introduces students to R, a widely used statistical programming language. Students will learn to manipulate data objects, produce graphics, analyse data using common statistical methods, and generate reproducible statistical reports. Student will also learn data mangling*.

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I	**Module 1: Introduction to R** • Introduction and installation of R and RStudio • Data types, vectors, multidimensional array. • Functions and their use • Visualization using ggplot2. • Word-Count program using Java	24
II	**Module 2: Hands-On MongoDB, Cassandra** • Installation of VM-Ware and Cloudera • Hands-On Mongo DB: CRUD, Where, Aggregation • Hands-On Mongo DB: Projection, Aggregation • Hands-On Cassandra DB: CRUD, Projection	
III	**Module 3: Hands-On PIG & HIVE** • Hands-On PIG • Hands-On HIVE • Twitter Data Fetching using Flume	

Reference Books:

- Paul Teetor. R Cookbook: Proven recipes for data analysis, statistics, and graphics. O'Reilly Media, Inc.,2011.
- Norman Matloff. Theart of R programming: A tour of statistical software design. No Starch Press, 2011.
- Winston Chang. R graphics cookbook. O'Reilly Media, Inc., 2012.
- Hadley Wickham and Garrett Grolemund. R for data science. 2016.
- Phil Spector. Data manipulation with R. Springer Science& Business Media, 2008.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcomes: At the end of the course, student is able to:

- CO1: Apply R-Studio, read R documentation, and write R scripts.
- CO2: Analyse the data using data analytics latest tools based on HDFS like Pig, Hive.
- CO3: Implement the aggregation projection on data set using Cassandra, MongoDB.
- CO4: Implement the concept of PIG & HIVE Using QVERIESON real world data

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO5/PSO4
CO2	PO1,PO5/PSO3
CO3	PO2,PO5/PSO3
CO4	PO5/PSO4

BCSE0191: BUSINESS INTELLIGENCE PROJECT

Credits: 02 **L–T–P: 0–0–0**

Project No.11. Air-Traffic arrival as well as departure Visualization Project in Business Intelligence

Objective: Create a visual panel (report) with multiple prompts and filters to show multiple stages of Aeroplane Movement

Project No.12. University Placement Activity Visualization Project

Objective: Create multiple reports to visualize all kinds of placement activity such as placed students with unplaced students, company wise placed students, visited companies, upcoming companies etc. with filters and prompts

Project No.13. Presentation of Wal-Mart sales (region and product wise)

Objective: Create Dashboard for displaying multiple products and their sales analysis using multiple report types such as gauge chart, crosstab, pie chart etc and also represent it by colours such as high selling product in green, low selling product in red in same way for different region as well.

Project No. 14. Country Crime Statistics Reporting Project in Business Intelligence

Objective: Display multiple crime reports with drill down feature like from country to state and state to district and district to city…with filtering capability for various reasons such as display of city or state which had highest number of crimes.

Project No.15. Stock Market Statistics reporting Project in Business Intelligence

Objective: Display trends of various companies' shares with drill down as well as drill up feature on date basis

Project No.16. Company's Revenue Report Project in Business Intelligence

Objective: compares how different order methods are performing for each product line. This report should display the revenue that individual order methods generate for each product line and the average revenue all order methods generate for each product line.

Project No. Sales Performance Reporting Project

Objective: The Vice President of Sales has requested a report that shows sales performance in each country for 2012. He wants to see the performance for representatives in Southern Europe so he can present an award to the top seller when he visits next month

Project No.18.Create a Report Focused on Top Performing Product Types and Product Lines

Objective: create a report that displays revenue by product line and product type. The report must show the product types that generated revenue greater than $100 million and product lines that generated revenue greater than $400 million with various charts and colouring scheme

Project No.19. Designing of Dashboard for various aspects

Objective: create a dashboard report that contains a gauge chart that compares the gross profit of each product line by region, a combination chart that shows revenue earned by each product line by retailer type and region on separate axis, and finally a crosstab report that shows the gross margin of each product line by year and region.

Project No.20. Sales Titled reporting (with multiple perspectives) Project

Objective: You have been asked for a report that displays the quantity of products sold for each order year. You also need to display all product lines in uppercase. The report should contain an optional prompt that lets users view data by sales region. Add a report title that indicates which sales region users select in the prompt. It should also indicate if they do not select a region as well. You will use a layout calculation to display the report title

Project No. 21. Employee Development Program Reporting Project

Objective: HR would like a report that outlines the courses each employee has completed. They want to see the number of course days that each employee has accumulated to date and the cost of those courses. They would also like to be able to drill-through to specific information on each employee for each year.

Project No.22.Production analysis and it Planning Reporting Project

Objective: prepare a report that shows the quantity of products sold in each month of 2012 for all product lines, to help estimate production requirements for next year. The report must be broken into separate sections for each product line so that products from each line can be analyzed separately. The report name and logo must appear at the top and bottom of each page of the report.

Project No.23. Bollywood Movies trends reporting Project

Objective: This is to create Bollywood Movies reports with filter and prompts to let user to find out list of movies based on different users' taste (e.g. emotional, scary ..Etc) and also show other report to show most/least user rated movie

Project No.24. Analysis of Profit reporting Project in Business Intelligence

Objective: create a list report where users can review the gross profit generated by retailer types for each region gained by XYZ (product wise) providing multiple filter and prompts and also name the report

Project No.25. Analysis on various income class of any country population

Objective: Create a dashboard where a manager can visualize various Income class of people based on region (country, state, district and so on...) providing multiple prompts and filter to drill down in reporting levels

BCSE0192: BIG DATA ANALYTICS PROJECTS

Credits: 2 **L–T–P-J: 0–0–0-0**

Project No. 1.House Price Prediction

Objective: Floor area, River view many factor affect the house price. Predict price of houses.

Project No. 2.Predict Customer Churn

Objective: Companies invest significantly to acquire new customers. So, after acquisition, companies would like these customers to stay long and be loyal. Companies also make investments to keep engaging with these customers continuously and ensure they are happy and satisfied with their offerings. Losing customers mean loss of investment and loss of possible future revenue. So, it is important for companies to infer early signs of a customer about to churn and engage or offer incentives to retain them. But as targeting each customer is not possible, companies can take advantage of analytics to predict if a customer high probability of churning. A possible intervention can be made to retain the customer.

Project No. 3.Predict Coronary Heart Disease

Objective: There are many factors which affect heart so take most prominent of them and predict whether the patient may have risk of heart disease

Project No. 4.Twitter Trends Analysis

Objective: The community of users participating in social media tends to share about common interests at the same time, giving rise to what are known as social trends. A social trend reflects the voice of a large number of users which, for some reason, becomes popular in a specific moment. Through social trends, users therefore suggest that some occurrence of wide interest is taking place and subsequently triggering the trend. In this work, we explore the types of triggers that spark trends on the micro blogging site Twitter, and introduce a typology that includes the following four types: news, ongoing events, memes, and commemoratives. The user will be allowed to search for the latest trends by inputting a keyword into search field. Based on user provided keyword, the system will search for similar keywords in database and summarize the total count to provide the trending tweets on twitter. The trending tweets with hashtag (#) will be displayed first and then the rest words will be displayed. By clicking on every trending tweet, the user commented tweets will be displayed. User can view all the tweets from the searched keyword.

Project No. 5.Stock Price Prediction

Objective: Predict the price stocks based on current trending factors.

Project No. 6.Movielens: Top 20 best rated movies

Objective: Find out 20 worst rated movies. But only consider those movies which are rated by at least 100 users. Find out best 10 and worst 10 movies in each category - Categories are tags given in the movies.

Project No. 7.Sales Performance Prediction

Objective: predict sales performance based on factors such as marketing expenditure, advertisement and others.

Project No. 8. Recommending movies to users using Collaborative Filtering

Objective: Knowing "What customers are most likely to buy in future" is key to personalized marketing for most of the businesses. Understanding customers past purchase behavior or customer demographics could be key to make future buy predictions. But how to use the customer behavior data, depends on many different algorithms or techniques. Some algorithms may use demographic information to make these predictions. But most of the times, the organizations may not have these kind of information about customers at all. All that organization will have been what customers bought in past or if the liked it or not. Recommendation systems use techniques to leverage this information and make recommendation, which has been proved to be very successful. For examples, Amazon.com's most popular feature of "Customers who bought this also buys this?"

Project No. 9. Detect Emotion in Text

Objective: When you read, "Why don't you ever text me", does it conveys an angry emotion or sad emotion?

Understanding Emotions in Textual Conversations is a hard problem in absence of voice modulations and facial expressions.

Project No. 10. Identify your Digits

Objective: Study, analyze and recognize elements in the images. That's exactly how your camera detects your face, using image recognition! It's your turn to build and test that technique. It's a digit recognition problem.

SYLLABUS

OF

PROGRAM ELECTIVE

BOUQUET: HIGH PERFORMANCE COMPUTING

DEPARTMENT OF COMPUTER ENGINEERING & APPLICATIONS

Under

Choice Based Credit System (CBCS)

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: High Performance Computing									
Theory									
1.	BCSE0201	Advanced Computer Architecture	3	0	0	0	3	3	Computer Organization
2.	BCSE0202	Embedded System	3	0	0	0	3	3	Microprocessors
3.	BCSE0203	Internet of Things	3	0	0	0	3	3	Microprocessors
4.	BCSE0204	Internet of Things and Its Applications	3	0	0	0	3	3	
5.	BCSE0205	Distributed System	3	0	0	0	3	3	CN /OS
6.	BCSE0206	Parallel Algorithms	3	0	0	0	3	3	CO& Algorithms
7.	BCSE0207	Cloud Computing	3	0	0	0	3	3	
8.	BCSE0208	Cloud Computing and Virtualization	3	0	0	0	3	3	
Labs									
1.	BCSE0231	Embedded System Lab	0	0	2	0	1	2	
2.	BCSE0232	Internet of Things Lab	0	0	2	0	1	2	
3.	BCSE0233	Parallel Algorithms Lab	0	0	2	0	1	2	
4.	BCSE0234	Cloud Computing lab	0	0	2	0	1	2	
Projects									
1.	BCSE0241	Internet of Things Project	0	0	0	-	2	-	
2.	BCSE0242	Cloud Computing and Virtualization Project	0	0	0	-	2	-	

BCSE0201: ADVANCE COMPUTER ARCHITECTURE

Objective: *The objective is to describe the operation of modern and high performance computers and ability to undertake performance comparisons of modern and high performance computers.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Review of Traditional Architectures:** Evolution of Computer Architecture, Review of Fundamentals of CPU, Memory & IO, Classes Of Computers & Trends In Architecture & Technology. **Introduction to High Performance Computing:** Need for Parallel Computing, Introduction to Parallel Computer Models, Parallel Architectural Classification Schemes, Speedup Performance Laws. **Program and Network Properties**: Condition of Parallelism, data and resource dependence, Grain Size and Latency, System interconnect architecture- Mesh, cube, butterfly, hypercube, PM2I, Bus system. **Pipelining Techniques:** Introduction to Pipelining, Instruction Pipeline, Arithmetic Pipeline, Hazards, Hazards Detections and Resolution, Instruction Prefetching, Branch Handling Techniques. Scheduling of Static & Dynamic Pipelines.	21
II	**Memory:** Memory Hierarchy Technology, Cache Memory Organization, Memory Replacement Policies, Cache Coherence, Inclusion and Locality. **Shared Memory Organization**: Memory Interleaving, Bandwidth and Fault Tolerance, Memory Allocation Schemes. **Parallel and Scalable Architectures:** Multiprocessor and Multicomputer, System Interconnects, Cache Coherence and Synchronization, Message Passing Mechanism. **Different Architectures:** Superscalar and Vector Processor, VLIW Architecture, Data flow Computer, Multicore Architecture	19

Text Books:

- Kai Hwang, NareshJotwani, "Advanced Computer Architecture", 2ndEdition, Tata McGraw-Hill,2011.

Reference Books:

- John L. Hennessy , "Computer architecture: A Quantitative Approach", 5th Edition, Elsevier,2011.
- AnanthGrama, George Karypis, Vipin Kumar, Anshul Gupta , "Introduction to Parallel Computing", 2ndEdition, Addison Wesley,2003.
- Bhujade, "Parallel Computing", 2ndEdition, New Age International,2011.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After completion of course, student will be able to:

- CO1: understand the fundamental knowledge in architecture design.
- CO2: Understand the concept of parallelism and pipelined processor design.
- different processor architectures and system-level design processes.
- CO3: Classify different Hazards Detections and their Resolution.
- CO4: Understand the components and operation of a memory hierarchy and the range of performance issues influencing its design.
- CO5: Understand the organization and operation of current generation parallel computer systems, including multiprocessor and Multicore systems.
- CO6: Understand the principles Superscalar and Vector Processor.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3/PSO2
CO2	PO1,PO5/PSO1
CO3	PO3,PO4/PSO3
CO4	PO5,PO7/PSO1
CO5	PO4 /PSO2
CO6	PO2,PO3/PSO1,PSO2

BCSE0202: EMBEDDED SYSTEM

Objective: *To acquaint students with methods of executive device control and to give them opportunity to apply and test those methods in practice.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I.	**Introduction:** Introduction to Embedded Systems, Hardware Needs Challenges and Design Process of Embedded System, Processor Architectures, Memory Organization, Embedded Devices and Its Network. **Architecture of Embedded System**: CPUs, Bus Based Computer Systems, Programming Design and Analysis, Model of Program, Basic Compilation Techniques, Program Optimization and Performance. **OS for Embedded Systems:** Real Time Operating System, ISR in RTOS, Basic Design Using an RTOS, RTOS Task Scheduling Models, RTOS Programming.	20
II.	**Software Architectures:** Processes and Operating Systems, Multiple Task and Multiple Processes, Preemptive RTOS, Priority Based Scheduling, Inter-process Communication Mechanism, Multiprocessors. **Program Modeling Concepts:** Program Model, DFG Models, Modeling of Multiprocessor Systems, UML Modeling, Embedded Software Development Process and Tools. **Networks &System Design Techniques:** Networks for Embedded and its Design, Internet Enabled System, Introduction to Sensor Network, Design Methodologies, Requirement Analysis, System Analysis and Quality Assurance.	20

Text Books:

- Wolf, Wayne , "Computers as Components - Principles of Embedded Computing System Design", Elsevier,2008.

Reference Books:

- Raj Kamal , "Embedded Systems–Architecture, Programming & Design", Tata McGraw Hill,2011.
- David A. Simon , "An Embedded Software Primer", Pearson Education,1999.
- DanielW.Lewis, "Fundamentals of Embedded Software Where C and Assembly Meet", 2nd Edition, Pearson College Division,2012.
- James K. Peckol, "Embedded Systems: A Contemporary Design Tool", Wiley India,2012.

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO6.

Outcomes: After completion of course, student will be able to:
- CO1: understand the Process of Embedded System.
- CO2: Understand different Model of Program.
- CO3: Understand the concept behind the RTOS and its scheduling.
- CO4: Classify the software architecture into Multiple Task and Multiple Processes.
- CO5: Understand different Program Modeling Concepts.
- CO6: Apply knowledge of embedded systems along with some specialization in any area of computer engineering.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO4,PO5/PSO2
CO2	PO3 /PSO1
CO3	PO5/PSO2
CO4	PO4,PO5/PSO1

CO5	PO2,PO3/PSO2
CO6	PO3,PO10/PSO2

BCSE0231: EMBEDDED SYSTEM LAB

Objective: *To enable the students to program, simulate and test the 8085, 8051, PIC 18 and ARM processor based circuits and their interfaces.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I/II	• ASCII to fixed-point output to LCD • Debugging, oscilloscope fundamentals, logic analyzer, dump profile • Alarm clock, LCD, edge-triggered input interrupts, and SysTick periodic interrupts • IEE802.11Wi-Fi communication, TCP, client-server, IoT • 12-bit DAC, SPI, Music player, audio amp • Introduction to PCB Layout, PCB Artist (paper design only) • Design and Layout of an Embedded System • Software Drivers for an Embedded System • Temperature measurement, ADC, LCD • DC motor control, timer interrupts, PWM output, input capture, integral control • Final Design and Evaluation of Embedded System	12*2=24

Text Books:

- Raj Kamal , "Embedded Systems–Architecture, Programming & Design", Tata McGraw Hill.2011.

Focus: This Course focuses on Employability under CO1,CO2.
Outcomes: After completion of Lab, student will be able to:

- CO1: Visualize and analyze the design and behavior of the hardware components.
- CO2: Apply knowledge of embedded systems along with some specialization in any area of computer engineering.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO5,PO7/PSO3
CO2	PO2,PO3/PSO2

BCSE0203: INTERNET OF THINGS

Objective: *To Implement Data and Knowledge Management and use of Devices in IoT Technology.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to IoT and Sensor:** Introduction to IoT- Sensing, Actuation, Logical design of IoT, Functional blocks/pillars/components of IoT, Communication models, IoT& M2M: Machine to Machine, Difference between IoT and M2M, **Introduction to Sensors:** About sensor, Properties of Sensors Basic physical principles of sensing, Categorization of Sensor, PIR Sensor, Temperature Sensor, Ultrasonic Sensor, IR Sensor, MQ2/MQ3 **Implementing IoT:** Introduction to Arduino Programming. Integration of Sensors and Actuators with Arduino. Implementation of IoT with Arduino, Node MCU. Mini project Statement using Node MCU.	20
II	**IoT Over Network:** IOT Networking Protocols: TCP/IP, 6LowPan, Routing Protocols, Thread. **Communication Protocol:** CoAP, SMCP, SMTP, HTTP, HTTPS, MQTT, MQTT-S SDN for IoT, Data Handling and Analytics. Cloud Computing, Fog Computing, Introduction to different IoT Tools. Implementation of IoT with Raspberry Pi.	20

Books for reference:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes:

- CO1: Understand the concepts of Internet of Things.
- CO2: Understand difference between Sensors and Actuators and their working principles.
- CO3: Design IoT applications using different sensors and actuators.
- CO4: Understand different protocols used in IoT over network.
- CO5: Understand different communication protocols.
- CO6: Explain the concept of cloud computing and fog computing.
- CO7: Implement IoT application using Raspberry Pi.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO2 /PSO4
CO3	PO5/PSO2
CO4	PO11/PSO2
CO5	PO1,PO3/PSO4
CO6	PO2/PSO1
CO7	PO5/PSO3

BCSE0204: INTERNET OF THINGS AND ITS APPLICATIONS

Objective: *This course introduces the various types of advance technology related to IoT, and their applications, also introduces the methods of interfacing sensors to electronic systems*.

Credits: 03 **Semester II** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Developing IoTs** Introduction to Python, Introduction to different IoT tools, developing applications through IoT tools, developing sensor based application through embedded system platform, Implementing IoT concepts with python **Challenges in IoT** Design challenges, Development challenges, Security challenges, Other challenges. **Advance Technology in IoT and its application** IoT with Big data and advanced Analytics-Big Data Metadata Management in Smart Grids: semantic inconsistencies role of metadata**,** Sensor deployment & Node discovery, Data aggregation & dissemination	20
II	**Cloud Computing:** AWS Cloud, Sensor-Cloud, Connected Vehicles. Introduction & Application to Industrial IoT. How to handle IoT devices using voice interface like Alexa/Goggle Home **Fog Computing**: A Platform for Internet of Things and Analytics, Definition-Characteristics-Application Scenarios -Issues -Fog Computing and Internet of Things-Pros and Cons-Myths of Fog Computing -Need and Reasons for Fog Computing Fog Computing and Edge Computing-IoT, FOG, Cloud-Benefits **Case study:** Agriculture, Healthcare, Activity Monitoring, Wearable Sensing, Smart Cities and Smart Homes. Security Of IoT devices	20

Text Books:

- Perry Lea , "Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Packt Publishing,2018

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.
Outcomes: After completion of Lab, student will be able to:

- CO1: Understand the concepts of Internet of Things.
- CO2: Understand difference between Sensors and Actuators and their working principles.
- CO3: Design IoT applications using different sensors and actuators.
- CO4: Understand the concept of cloud computing.
- CO5: Understand the concept of Fog computing.
- CO6: Understand the concept of Edge computing.
- CO7: Implement IoT application using Raspberry Pi.
- CO8: Understand the concept of security in IoT.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO2/PSO4
CO3	PO5/PSO2
CO4	PO10/PSO1
CO5	PO10/PSO4
CO6	PO10/PSO1
CO7	PO2,PO3/PSO2
CO8	PO5/PSO3

BCSE0232: INTERNET OF THINGS LAB

Objective: *Coordinate and help to increase and optimize the utilization of results and value creation in the area of IoT.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I/II/III	• WAP to interface and blink the LED using Arduino UNO. • WAP to interface for different sensors (Like DHT11, temperature, IR, Ultrasonic etc) to Arduino UNO. • WAP to interface temperature sensor to ESP8266. Turn on the LED if temperature value met threshold value. • WAP to interface in between Bluetooth module and Arduino UNO. • Write a python program for Gateway to store sensor data on local MySQL database. • WAP to transmit the data wirelessly for longer distance using multi-hop technique. • Configure the gateway as local MQTT broker (Mosquito), configure one ESP8266 as sender (Publisher), and receive the data on the Smartphone (MQTT Dashboard).	12*2=24

Text Books:

- Upskill Learning , "ESP8266: Programming NodeMCU Using Arduino IDE - Get Started With ESP8266 (Internet Of Things, IOT, Projects In Internet Of Things, Internet Of Things for Beginners, NodeMCU Programming, ESP8266",2018.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.
Outcomes: After completion of course, student will be able to:

- CO1: Design IoT applications using different sensors and actuators.
- CO2: Design IoT applications in different domain and be able to analyze their performance.
- CO3: Implement basic IoT applications on embedded platform.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3,PO5/PSO1
CO2	PO4/PSO1
CO3	PO1/PSO4

BCSE0241: IOT BASED PROJECT

Objective: *Identify research opportunities in IoT technology, applications and services, focusing on the context.*

Credits: 02 **L–T–P-J: 0–0–0-0**

1. IoT Weather reporting system using Raspberry pi:

Objective: This project helps you in weather reporting. We used many sensors that can help in sensing all-weather monitoring parameters and RaspberryPi gathers all the information from them and uploads it to the Things peak cloud, which is a wonderful application platform for IoT, where you can see the report that sensors send you.

2. IoT Connected Healthcare Applications:

Objective: The aim of developing this project is to monitor the health condition of a person anywhere and send the information to a specialized doctor to check up. Using this frequency of visiting doctor decreases. We developed a project using Wearable sensors with solar harvesting and Bluetooth low energy transmission that creates a wireless body area network (WBAN). Using this project, you can detect the heartbeat, Blood pressure, hemoglobin content etc., All these reports can be used for analyzing a person's health.

3. IoT Based Intelligent Traffic Management System:

Objective: As the population increases, the effort on Traffic is also increasing. In many metropolitan cities, it is being difficult for traffic Management team to control it. So, IoT can help the traffic system to be automated and monitor the traffic status using the internet.

4. IoT Based Smart Parking System Using RFID:

Objective: With the increase in usage of vehicles, Parking space is very difficult to find. We need to use the human effort to check where to park our vehicle. To overcome this problem, we developed Smart Parking system that shows you space to park your vehicle.

5. Smart Irrigation System Using IoT:

Objective: We have developed a Smart Irrigation system using the concept of IoT. As we know, farming has different stages, to help these farmers in understanding the climatic conditions, moisture content in the soil and to make their decisions easy we have developed Smart Irrigation System using IoT.

6. IoT Based Baby Monitoring System Using Raspberry Pi:

Objective: This project is to develop a smart umbrella system using IOT, which can measure rainfall and it can predict the weather condition with the notion in your smart phone. It is about the real-time weather condition and it can be design using Raspberry Pi.

7. IoT Based Fire Detection System Using FPGA:

Objective: Building a cloud based Fire monitoring system is very important to reduce the cost of maintaining servers, to avoid data losses and to make the access easy with multiple internet connected devices (computer, tablet, mobile phone) at the same time anywhere in the world. Using IOT. Here, we are going to design a fire detection system and data to be upload it to a Thing Speak cloud using FPGA

8. Cloud based Smart Energy meter using FPGA:

Objective: Efficient use of energy becomes more crucial when increase in the cost of energy is observed. Since energy management is required to define the amount of consumed energy in a specific period, utilization of Energy Meters is essential. It is possible to measure the consumed energy by using a simple energy meter. But sometimes the limited functionality of these meters restricts their area of application; especially in inaccessible positions or in the situations where visibility of the meter is poor, it is not possible to use such an appliance.

9. Data logger of Brain parameters in Google sheets using Mind wave mobile with Raspberry Pi:

Objective: Brain-Computer Interface technology is innovated to the analysis of the brain to predict the human thoughts or to control applications using the brain. As the next stage of analysis based on Machine Learning to our Brain, we need data logs of our Brain parameters, so we need the logs of data, which should contain Brain values. This can be done by using Raspberry Pi to take values from the Brain and to uploading the Brain values in Raspberry Pi.

10. MQTT based Monitoring System for Coal Mine using Raspberry Pi:

Objective: Due to global warming and climate, changes there are challenging situations in coalmine. To reduce the cost as well as to improve the productivity along with product quality the automation in the field of coalmine is necessary, which will also reduce the mine worker's efforts. This project proposes a design of a IOT system with MQTT protocol, by the help of Raspberry pi controller which is able to monitor the temperature, humidity, gas and status of smoke in an underground mine.

11. Industry Monitoring with data logger in Google sheet using Raspberry Pi:

Objective: This Raspberry Pi industry monitoring system which having some sensors, taking sensor values and converting using Analog to Digital, then for data logging which will be helpful to review the industry parameter, instead of data log manually, every data values will be uploaded to Google sheets which already get authenticated and by generating JSON file for every individual.

12. IoT Based Transmission Line Monitoring System Using Raspberry Pi:

Objective: The aim of this project is to decrease power consumption for delay sensitive and delay insensitive traffic. A fuzzy rule table is constructed with prediction of average inter arrival time of frame based on outcome sleep time and power is evaluated. Proposed method offer effective power efficiency than previous inter arrival time method using Raspberry Pi.

BCSE0205: DISTRIBUTED SYSTEMS

Objective: *The objective is to study the fundamental principles of distributed system and protocols. This course addresses communication, process, naming, synchronization, replication, and fault tolerance in distributed system.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Overview to Distributed Systems, Characteristics, Examples of Distributed Systems, Issues and Challenges, System Models. **Theoretical Foundation:** Limitation of DS, Introduction to Time and Global States, Clocks, Events and Process States, Synchronizing Physical Clocks, Logical Time and Logical Clocks, Global States, Introduction to Distributed Operating System – Layered Architecture. **Distributed Deadlock Detection:** Distributed Mutual Exclusion – Introduction, Classification, Algorithms and their performances, Deadlock Prevention, Avoidance, Detection and Resolution, Deadlock Detection (Centralized & Distributed) Algorithms and their performances. **Agreement Protocols:** Introduction, Classification, Solution to Byzantine Agreement Problem and Applications. **Distributed Objects:** Introduction to Interprocess Communications, Client Server Communication, Group Communication, Communication between Distributed Objects, Remote Procedure Call, Events and Notifications, Case Studies – Java RMI and CORBA.	20
II	**Distributed File System:** Introduction to DFS, File Service Architecture, Sun Network File System, Andrew File System, Name Services, DNS, Directory and Directory Services. **Fault Tolerance:** Issues in Fault Tolerance, Commit Protocols, Voting Protocols, Dynamic Voting Protocols. **Failure Recovery in Distributed Systems:** Concepts in Backward and Forward Recovery, Recovery in Concurrent Systems, Recovery in Distributed Database Systems. **Load Balancing:** Introduction, Issues, Components and load distributing algorithms – Sender – Initiated, Receiver – initiated, symmetrically – initiated and Adaptive algorithm. **Overview of Security Techniques:** Introduction to Cryptographic Algorithms, Digital Signatures, Replication, System Model and Group Communications, Active and Passive Transactions with Replicated Data.	20

Text Book:

- MukeshSinghal and Niranjan Shivaratri, “Advanced Concepts in Operating Systems”, McGraw-Hill Series in Computer Science,2017.

Reference Books:

- A.S. Tanenbaum and M. Van Steen , “Distributed Systems”, Pearson Education,2004.
- George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, 5th Edition, Pearson Education Asia,2011.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.
Outcomes: After completion of Lab, student will be able to:

- CO1: Understand basic elements and concepts related to distributed system technologies; and core architectural aspects of distributed systems.
- CO2: Identify the advantages and challenges in designing distributed algorithms for different primitives like mutual exclusion, deadlock detection, and agreement.
- CO3: Understand principle behind IPC and use various interposes communication techniques, such as remote method invocation, remote events for building distributed systems.

- CO4: Introduce the concepts of distributed file system with its architecture and components along with case studies.
- CO5: Distinguish the main failure types in a Distributed System and specify algorithms for achieving fault tolerance and error recovery within such a system.
- CO6: Understand how balancing of resources is done; issues, components and algorithms for load balancing in distributed environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2,PO3/PSO1,PSO2
CO4	PO1,PO2/PSO1,PSO2
CO5	PO1,PO2/PSO1
CO6	PO1,PO2,PO4/PSO1

BCSE0206: PARALLEL ALGORITHM

Objective: *This course aims to introduce the concept of designing algorithms suitable for implementation on parallel computers. The focus will be on the algorithmic side. In particular, the emphasis will be on studying different parallel techniques and using them to design scalable parallel algorithms for a variety of problems and architectures.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Need for parallel computers, Models of computation, analyzing parallel algorithms, Expressing parallel algorithms **Algorithm Models:** Sequential model, need of alternative model, parallel computational models such as PRAM, LMCC, Hypercube, Cube Connected Cycle, Butterfly, Perfect Shuffle Computers, Tree model, Pyramid model,Fully Connected model, CRCW-CREW, EREW models **Performance Measures of Parallel Algorithms:** Speed-upandefficiency of PA, Cost- optimality, an example to illustrate Cost-optimal algorithms- such as summation, Min/Max on various models.	20
II	**Decomposition& Mapping techniques:** Database query processing, 15-puzzle problem, Parallel discrete event simulation. **Sorting:** Hyper quick sort, Bitonic merge sort, Enumeration sort (sorting on the CRCW model, CREW model and EREWmodel) **Searching and selection:** Searching on a sorted sequence (EREW, CREW, CRCW), Sequential selection algorithm, Parallel selection algorithm (EREW parallel solution) **Graph algorithms:** Graph coloring, Minimal spanning tree, Shortest path algorithm	20

Text Books:

- M.J. Quinn, "Designing Efficient Algorithms for Parallel Computer", McGraw-Hill, Inc, ISBN:0-07-051071-7,1987.

Reference Books:

- S.G. Akl, "Design and Analysis of Parallel Algorithms". Prentice-Hall, Inc., ISBN:0-13-200056-3,1989.
- S.G. Akl," Parallel Sorting Algorithm" by Academic Press,1985.
- AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to Parallel Computing", Second Edition, Addison Wesley, ISBN: 0-201-64865,2003.

Focus: This Course focuses on Employability under CO1,CO2,CO4.
Outcomes: After completion of course, student will be able to:

- CO1: understand the requirement for parallel computers.
- CO2: understand different Sequential and parallel computational models.
- CO3: Analyze the performance of Parallel Algorithms.
- CO4: Understand the system for parallel Database query processing.
- CO5: Understand the system for parallel searching and sorting algorithms.
- CO6: Understand the system for parallel graph algorithms.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO10/PSO2
CO2	PO5/PSO1
CO3	PO4/PSO2
CO4	PO1/PSO3
CO5	PO2 /PSO2
CO6	PO1,PO4/PSO3

BCSE0233: PARALLEL ALGORITHM LAB

Objective: *The goal of the course is to study the mathematical models, methods and technologies of parallel programming for multiprocessor systems.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I/II/III	• Parallel Programming with MPI • Parallel Programming with OpenMP • Lab for estimating the parallel method efficiency with the use of the ParaLab system • Lab for developing the parallel algorithms and programs • Lab works for parallel solving partial differential equations • Lab works for studying the parallel method libraries • Lab works for parallel solving the problem of multidimensional multiextremal optimization	12*2=24

Text Books:

- M.J. Quinn, "Designing Efficient Algorithms for Parallel Computer", McGraw-Hill, Inc, ISBN:0-07-051071-7,1987.

Focus: This Course focuses on Employability under CO1,CO2.
Outcomes: After completion of course, student will be able to:

- CO1: Understand the concept of MPI
- CO2: Design parallel software for solving the problems of sufficiently high level of complexity.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3
CO2	PO5/PSO2

BCSE0207: CLOUD COMPUTING

Objective: *This course covers aims to explain various technologies related to Cloud Computing and their practical implementations, discuss different architectural models of cloud computing, the concepts of virtualization and cloud orchestration.*

Credits: 03 **Semester - VI** **L–T–P-J: 3–0–1-0**

Module No.	Content	Teaching Hours
I	**Overview of Cloud Computing -** Brief history and Evolution of Cloud Computing, Traditional vs. Cloud Computing, Importance of Cloud Computing, Benefits and Challenges of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing, Role of Open Standards Cloud **Computing Architecture:** Cloud computing stack Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services Service Models (XaaS) Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS) Deployment Models Public cloud, Private cloud, Hybrid cloud, Community cloud. **Infrastructure as a Service(IaaS):** Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM) Resource Virtualization Server, Storage, Network Virtual Machine (resource) provisioning and manageability, storage as a service, Data storage in cloud computing (storage as a service) Case Study: Amazon EC2. **Platform as a Service(PaaS):** Introduction to PaaS What is PaaS, Service Oriented Architecture (SOA) Cloud Platform and Management Computation Storage, Case study: Microsoft Azure as PaaS, Introduction, Service Offered, Creation of DB instance.	20
II	**Software as a Service (SaaS):** Introduction to SaaS, Web services, Web 2.0, Web OS, Open SaaS, SaaS with SOA Overview of Multi-Cloud Management Systems - Explain concept of multicloud management, Challenges in managing heterogeneous clouds, benefits of multi-cloud management systems. **Overview of Cloud Security -** Security concerns in Traditional IT, Challenges in Cloud Computing in terms of Application, Server, and Network Security. Security Concepts in VM, Abuse and Nefarious Use of Cloud Computing, Insecure Interfaces and APIs (Malicious Insiders, Shared Technology Issues, Data Loss or Leakage, Account or Service Hijacking, Unknown Risk Profile), Attacks in Cloud Computing **Cloud Security:** Infrastructure Security, Network level security, Host level security, Application level security Data security and Storage Data privacy and security Issues, Jurisdictional issues raised by Data Location Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, IAM User, Groups and their Roles. **Service Management in Cloud Computing:** Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously Managing Data Looking at Data, Scalability & Cloud Services Database & Data Stores in Cloud Large Scale Data Processing.	20

TextBooks:

- Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski, "Cloud Computing": Principles and paradigms,2011.

ReferenceBook:

- Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter Cloud Computing: A Practical Approach,2010.
- McGraw Hill. Rittinghouse, John, W, Cloud computing: Implementation, management and security.
- Barrie Sosinsky, Cloud Computing Bible, Wiley.2011.
- Rhoton, John, Cloud Computing Architected: Solution Design Handbook.
- Krutz, Ronald L.; Vines, Russell Dean, Cloud Security, A comprehensive Guide to Secure Cloud Computing.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After successful completion of this student will be able to:

- CO1: Describe importance of virtualization along with their technologies like system, network, and storage virtualizations.
- CO2: Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, XaaS, Public Cloud, Private Cloud, Hybrid Cloud and the core issues of cloud computing such as security, privacy, and interoperability.
- CO3: Justify the need of new technology of Virtualization & Cloud Computing and its ecological impact.
- CO4: Identify the known threats, risks, vulnerabilities and privacy issues associated with Cloud based IT services
- CO5: Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost
- CO6: Identify the Challenges in managing heterogeneous clouds.
- CO7: Analyze various cloud programming models and apply them to solve problems on the cloud.
- CO8: Describe the key components of Amazon web Service

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO7/PSO2
CO2	PO1,PO3,PO7/PSO1
CO3	PO1,PO7/PSO1
CO4	PO1,PO3,PO5/PSO4
CO5	PO1,PO3,PO5,PO7/PSO4
CO6	PO1,PO3,PO5 /PSO2
CO7	PO1,PO3,PO5/PSO1
CO8	PO1,PO3,PO5,PO7/PSO1,PSO2

BCSE0208: CLOUD COMPUTING AND VIRTUALIZATION

Objective: *This course covers aims to explain various technologies related to Cloud Computing and their practical implementations, discuss different architectural models of cloud computing, the concepts of virtualization and cloud orchestration.*

Credits: 03 **Semester III** **L–T–P-J :3–0–0-0**

Module No.	Content	Teaching Hours
I	**Overview of Cloud Computing -** Brief history and Evolution of Cloud Computing, Traditional vs. Cloud Computing, Importance of Cloud Computing, Benefits and Challenges of Cloud Computing, Cloud computing vs. Cluster computing and Grid computing **Cloud Computing Architecture:** Cloud computing stack Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, Role of Web services, Service Models (XaaS), Infrastructure as a Service(IaaS) , Platform as a Service(PaaS), Software as a Service(SaaS), Deployment Models, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud. **Infrastructure as a Service (IaaS)**: Introduction to virtualization, Different approaches to virtualization, Hypervisors and its types, Virtual Machine(VM), Resource Virtualization, Server Virtualization, Storage Virtualization, Network Virtualization, Virtual Machine Resource Provisioning and Manageability, Data storage in cloud computing (storage as a service), VM migration techniques, - Case Study: Amazon EC2. **Platform as a Service(PaaS):** Introduction to PaaS, Service Oriented Architecture (SOA), Cloud Platform and Management Computation Storage. **Software as a Service (SaaS:)** Introduction to SaaS, Web services, Web 2.0, Web OS, Open SaaS, SaaS with SOA.	19
II	**Load balancing**: Types of Load Balancing Scenarios in Cloud Computing Environment, Static, Dynamic and Centralized algorithms, Introduction to Open Stack, Horizon Web Interface, Using Keystone Identity Service, Swift Object Storage Service, Glance Image Service, Cinder Block Storage Service, Neutron Networking Service, and Nova Compute and Controller. **Overview of Cloud Security -** Security concerns in Traditional IT, Challenges in Cloud Computing in terms of Application, Server, and Network Security. Security Concepts in VM, Abuse and Nefarious Use of Cloud Computing, Insecure Interfaces and APIs (Malicious Insiders, Shared Technology Issues, Data Loss or Leakage, Account or Service Hijacking, Unknown Risk Profile), Attacks in Cloud Computing. **Cloud Security**: Infrastructure Security, Network level security, Host level security, Application level security Data security and Storage Data privacy and security Issues, **Energy Efficiency in Clouds**: Data Center Power Consumption, Green Data Centers. **Overview of Multi-Cloud Management Systems -** Explain concept of multi-cloud management, Challenges in managing heterogeneous clouds, benefits of multi-cloud management systems.	20

Text Book:

- Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski, "Cloud Computing": Principles and paradigms,2011.

Reference Books:

- Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter ," Cloud Computing": A Practical Approach, McGraw Hill,2010.
- Rittinghouse, John, W, "Cloud computing" : Implementation, management and security.
- Barrie Sosinsky," Cloud Computing Bible", Wiley. 2011
- Rhoton, John, "Cloud Computing Architected": Solution Design Handbook.
- Krutz, Ronald L.; Vines, Russell Dean, Cloud Security, A comprehensive Guide to Secure Cloud Computing.

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO8.

Outcomes: After completion of Lab, student will be able to:

- CO1: Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, XaaS, Public Cloud, Private Cloud, Hybrid Cloud and the core issues of cloud computing such as security, privacy, and interoperability.
- CO2: Describe importance of virtualization along with their technologies like system, network, and storage virtualizations.
- CO3: Understand the concept of VM migration.
- Co4: Understand the concept of web services and SOA.
- CO5: Understand the concept of load balancing in cloud environment.
- CO6: Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost.
- CO7: Understand the concept of multi cloud management.
- CO8: Explain the key components of Amazon web Service and Microsoft Azure.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO7/PSO1
CO2	PO1,PO3,PO5,PO7/PSO2
CO3	PO1,PO5/PSO1
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO5/PSO1,PSO4
CO6	PO1,PO3,PO5,PO7/PSO4
CO7	PO1,PO3,PO5/PSO2
CO8	PO1,PO3,PO5,PO7/PSO1,PSO2

BCSE0234: CLOUD COMPUTING LAB

Objective: *This lab aims to understand the concept of cloud and virtualization by the help of VMware.*

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I/II	• 1. a) Introduction to Packet Tracer. • b) Network Topologies. (Including explanation of Simple PDU & Complex PDU.) • 2. Connecting 3 netwoks using routers. Also, configure DHCP and DNS server. • 3. Configuration of different Application services (SMTP, FTP, HTTP, TFTP, DHCP & DNS) • 4. Configuration of Vlan and Inter- Vlan Routing. • 5. Configure GRE over IP tunnel (VPN). • 6. Static NAT configuration. • 7. Configure Wireless network. • 8. Configure different IoT devices. • 9. Management of cloud resources using Cloud Analyst. • 10. Simulation of large scale Cloud computing data centers with Cloud Analyst • 11. Study on VMware • a. Creating a VM • b. Networking on VM • c. Merging and splitting disk on VM • d. Cloning the guest OS • e. Deploying VM with template • f. Creating Snapshots • g. Managing Users, Groups, Permissions and Roles • 12. Crating a EC2 instance on AWS • 13. Configuration of db in AWS. • 14. Creation of S3 bucket with single IAM user in AWS. • 14. Creating a AWS infrastructure for an organization on cloudcraft	12*2=24

Reference Book:

- Raj Kumar Buyya, James Broberg, Andrezei, M. Goscinski," Cloud Computing": Principles and paradigms,2011.

Focus: This Course focuses on Employability, Skill Development and Entrepreneurship under CO1,CO2,CO3,CO5.

Outcomes: After completion of Lab, student will be able to:

- CO1: Understanding about the virtualization by the help of VMware.
- CO2: Understanding of CISCO packet tracer to build a cloud network infrastructure.
- CO3: Explain the key components of Amazon web Service and Microsoft Azure.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/PSO1
CO2	PO1,PO3,PO5/PSO1
CO3	PO1,PO3,PO5,PO7/PSO2

BCSE0242: CLOUD COMPUTING PROJECT

L–T–P: 0–0–-

Credits: 02

ehouse application using force.com cloud platform:

Objective: Force.com platform is a cloud service fits in the Platform as a Service model. Developers can leverage the runtime time environment and develop scalable web applications using Force.com platform. Design a warehouse application using Multi-Tenant MVC architecture of Force.com. The application should consist of all modules required to automate the warehouse and also it be able to accessible via android mobile.

2. Performance benchmarking of Type I Hypervisors:

Objective: The virtualization is carried out by the software layer called as the Hypervisor or Virtual Machine Monitor (VMM). Hypervisor is widely used in cloud datacenters. Benchmark is the measurement of best practice performance. Benchmarking is very essential term for the discovery of the best performance given by the particular system. Benchmarking can provide you the external references and the best practices on which to base your evaluations and to design your system processes which can be very useful in finding the gaps in the system to achieve the desired performance. Your target hypervisors are Xen, VMwareEsxi (Free edition) and Hyper V (Community Edition). Performance analysis of network, cuprum, I/O need to carried out.

3. AgriERP: Agriculture Enterprise resource planning on cloud:

Objective: Agriculture management is complex, requires intimacy with the environment supporting the farm and must meet the specific needs of the farm family it supports in the community where they live. So this project is based on carrying and management of farming activities. By this project you are intended to reduce management worries and regular information of paper written form. Also you provide provision to farmers which give information regarding market update, weather report, and equipment information. Your ultimate goal is to enhance use of farming resource by using modern technology. Application can be developed using Force.com cloud platform.

4. Performance benchmarking of Type II Hypervisors:

Objective: The virtualization is carried out by the software layer called as the Hypervisor or Virtual Machine Monitor (VMM). Hypervisor is widely used in cloud datacenters. Benchmark is the measurement of best practice performance. Benchmarking is very essential term for the discovery of the best performance given by the particular system. Benchmarking can provide you the external references and the best practices on which to base your evaluations and to design your system processes which can be very useful in finding the gaps in the system to achieve the desired performance. Your target hypervisors are Virtual Box, VMWare workstation as a hosted hypervisors and KVM. Performance analysis of network, cuprum, I/O need to carried out.

5. Configure a devstack environment in personal computer and create a image with LAMP stack and deploy web an application:

Objective: DevStack is an opinionated script to quickly create an OpenStack development environment. It can also be used to demonstrate starting/running OpenStack services and provide examples of using them from a command line. Your objective is to deploy private cloud using devstack and create a necessary network components and projects. Than configure an image with (LAMP), Linux-Apache-MySQL-PHP. Develop a web application using html, PHP and MySQL database and deploy it on devstack.

6. Develop a three-tier web application using Web 3.0 Technologies and deploy it on AWS EC2 service with auto scaling property:

Objective: Amazon web services is a Public cloud provider consists of many services like storage, database, compute and container services. It also consists of advanced services like AI, Image voice recognition and other allied services. The high end three tier applications are with huge complex structure like e-commerce sites, social media sites and other variety of application where quality of user experience is most important.

These types of applications can leverage the clouds on the fly based on the resource demands. Your objective is to create a web application using latest web technologies. Deploy the application by provisioning the EC2 instances of type micro. Perform auto scaling by generating high http network traffic using http-perf.

7. Performance benchmarking of Type I Hypervisors and containers:

Objective: The virtualization is carried out by the software layer called as the Hypervisor or Virtual Machine Monitor (VMM). Hypervisor is widely used in cloud datacenters. Benchmark is the measurement of best practice performance. Benchmarking is very essential term for the discovery of the best performance given by the particular system. Benchmarking can provide you the external references and the best practices on which to base your evaluations and to design your system processes which can be very useful in finding the gaps in the system to achieve the desired performance. Your target hypervisors are Virtual Box, VMWare workstation as a hosted hypervisors and KVM. Performance analysis of network, CPU, RAM I/O need to carried out.

8. Design and deploying of web application in Docker container:

Objective: Docker is an open-source project that automates the deployment of applications inside software containers. Docker containers wrap up a piece of software in a complete file system that contains everything it needs to run: code, runtime, system tools, and system libraries – anything you can install on a server. Docker provides an additional layer of abstraction and automation of operating-system-level virtualization on Windows and Linux. Docker uses the resource isolation features of the Linux kernel such as cgroups and kernel namespaces, and a union-capable file system such as Overlays and others to allow independent "containers" to run within a single Linux instance, avoiding the overhead of starting and maintaining virtual machines. The objective of proposed study is to deploy the containers on Docker. In that one container is a web server which has a web application which may be of any language such as java, python etc. and another containers consists of database of application. We had to connect these two containers and access the application of first container in third container with database connectivity.

9. Minisat: Open source provisioning, managing and monitoring tool for virtual machines:

Objective: The web interface allows the user to interact with the underlying infrastructure to manage its provisions. Technologies, which can be used to do so, are HTML, CSS, and Django. Application Server, which is the master node, will be used to provision the requirements of a user by using libvirt API. It will be able to monitor the status of VMs. Worker Node is the physical machines on which the VM will be provisioned.

10. Develop a three-tier web application using Web 3.0 Technologies and deploy it on Google compute service with auto scaling property:

Objective: Google compute services is a Public cloud provider consists of many services like storage, database, compute and container services. It also consists of advanced services like AI, Image voice recognition and other allied services. The high end three tier applications are with huge complex structure like e-commerce sites, social media sites and other variety of application where quality of user experience is most important. These type of applications can leverage the clouds on the fly based on the resource demands. Your objective is to create a web application using latest web technologies. Deploy the application by provisioning the EC2 instances of type micro. Perform auto scaling by generating high http network traffic using http-perf.

11. Performance analysis of load balancing algorithms in cloud heterogeneous environment:

Objective: The pervasiveness and power of cloud computing alleviates some of the problem's application administrators face in their existing hardware and software environments. However, the rapid increase in scale, dynamicity, heterogeneity, and diversity of cloud resources necessitates having expert knowledge about the way resources are scheduled. The project gives an insight on key resource types of cloud, its resource orchestration along with the analysis of the performance of algorithms.

12. Cloud Log Forensics: Foundations, State of the Art, and Future Directions:

Objective: Cloud log forensics (CLF) mitigates the investigation process by identifying the malicious behavior of attackers through profound cloud log analysis. However, the accessibility attributes of cloud logs obstruct accomplishment of the goal to investigate cloud logs for various susceptibilities. Accessibility involves the issues of cloud log access, selection of proper cloud log file, cloud log data integrity, and trustworthiness of cloud logs. Therefore, forensic investigators of cloud log files are dependent on cloud service providers (CSPs) to get access of different cloud logs.

13. Adaptive Threshold-Based Approach for Energy-Efficient Consolidation of Virtual Machines in Cloud Data Centers:

Objective: The rapid growth in demand for computational power driven by modern service applications combined with the shift to the Cloud computing model have led to the establishment of large-scale virtualized data centers. Such data centers consume enormous amounts of electrical energy resulting in high operating costs and carbon dioxide emissions. Dynamic consolidation of virtual machines (VMs) and switching idle nodes off allow Cloud providers to optimize resource usage and reduce energy consumption. However, the obligation of providing high quality of service to customers leads to the necessity in dealing with the energy-performance trade-off. A novel technique for dynamic consolidation of VMs based on adaptive utilization thresholds, which ensures a high level of meeting the Service Level Agreements (SLA). We validate the high efficiency of the proposed technique across different kinds of workloads using workload traces from more than a thousand Planet Lab servers.

14. An SLA-based Admission Control for a Software-as-a-service Provider in Cloud Computing Environments:

Objective: Software as a Service (SaaS) provides access to applications to end users over the Internet without upfront investment in infrastructure and software. To serve their customers, SaaS providers utilize resources of internal data centres or rent resources from a public Infrastructure as a Service (IaaS) provider. In-house hosting can increase administration and maintenance costs whereas renting from an IaaS provider can affect the service quality due to its variable performance. To overcome these limitations, we propose innovative admission control and scheduling algorithms for SaaS providers to effectively utilize public Cloud resources to maximize profit by minimizing cost and improving customer satisfaction level.

15. The Aneka Platform and Qos-driven Resource Provisioning for Elastic Applications on Hybrid Cloud:

Objective: How Aneka, a platform for developing scalable applications on the Cloud, supports a vision of QOS by provisioning resources from different sources and supporting different application models. We highlight the key concepts and features of Aneka that support the integration between Desktop Grids and Clouds and present an experiment showing the performance of this integration.

16. Data Leakage Detection Using Cloud Computing:

Objective: This project presents a data leakage detection system using various allocation strategies and which assess the likelihood that the leaked data came from one or more agents. For secure transactions, allowing only authorized users to access sensitive data through access control policies shall prevent data leakage by sharing information only with trusted parties and also the data should be detected from leaking by means of adding fake record`s in the data set and which improves probability of identifying leakages in the system. Then, finally it is decided to implement this mechanism on a cloud server.

17. Suboptimal Mechanism for load balancing in cloud:

Objective: Load balancing is important and major issue for cloud networks due to its elastic nature, user's unpredictable behavior and difficulty faced to foresee the request issued to the server. In order to efficiently utilize cloud resources, a new methodology for dynamic resource allocation based on the suboptimal mechanism of aggregation i.e. GIT (greedy incremental tree) is needed. The proposed technique improves path sharing at time of migration during load balance process. A cloud workload network is constructed based on-Greedy heuristics having the characteristics to build incrementally diverse set, selecting one compute node at a time to maximize diversity measure. The virtual machine manager can rely on the rules and can make efficient decision for optimal provisioning of virtual machine based on the aggregated route.

18. Towards Many-Core Processor Simulation on Cloud Computing Platforms:

Objective: There is a need for a many-core simulator that can be simple to use and learn from for students, dynamic and capable of emulating large systems for researchers, and flexible with fast turnover for industry designers. At the same time, as many-core systems have been becoming popular and complex, and hence their design, the long-standing field of Cloud Computing has become more prevalent and feasible to use. Therefore, the projects deal with the designing of many core processors on simulator.

19. Consumer Acceptance of Cloud Computing Based Gaming:

Objective: There is a lack of understanding on how the users perceive cloud gaming. Investigating the factors that affect the users' acceptance of cloud gaming is crucial in deter-mining the future of this new platform. A lack of awareness regarding these factors may lead to the users‟ rejecting the new technology. This is a research-based project, conducted through an inductive approach, using a survey as a research method, where the primary data comes from a structured interview. A descriptive study is conducted in order to obtain the full set of user-related features of cloud gaming. After that, the technology acceptance model is utilized in order to find out the user perception of these features.

20. Application performance Isolation in Cloud:

Objective: Performance isolation is the desirable thing in virtual machine based infrastructure to meet Service Level Objectives. Many experiments in this area measure the performance of applications while running the applications in different domains, which gives an insight into the problem of isolation. We run different kind of benchmark s simultaneously in virtual environment to evaluate the isolation strategy provided by the hypervisor.

21. Optimistic Synchronization of Parallel Simulations in Cloud Computing Environments:

Objective: Cloud computing offers the potential to make parallel discrete event simulation capabilities more widely accessible to users who are not experts in this technology and do not have ready access to high performance computing equipment. Services hosted within the cloud and can potentially incur processing delays due to load sharing among other active services, and can cause optimistic simulation protocols to perform poorly. This project proposes a mechanism termed the Time Warp Straggler Message Identification Protocol (TW-SMIP) to address optimistic synchronization and performance issues associated with executing parallel discrete event simulation in cloud computing environments

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SYLLABUS

OF

PROGRAM ELECTIVE

BOUQUET: DEVELOPMENT TOOLS AND TECHNOLOGIES

DEPARTMENT OF COMPUTER ENGINEERING & APPLICATIONS

Under

Choice Based Credit System (CBCS)

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Bouquet Development Tools and Technologies									
Theory									
1.	BCSE0251	Full Stack Using Scripting Technologies	3	0	0	0	3	3	
2.	BCSE0252	Full Stack using Node JS	3	0	0	0	3	3	
3.	BCSE0253	Full Stack using C#.net	3	0	0	0	3	3	
4.	BCSE0254	PHP - Scripting Language	3	0	0	0	3	3	
5.	BCSE0255	Digital Marketing and Transformation	3	0	0	0	3	3	
Labs									
1.	BCSE0281	Full Stack Using Scripting Technologies Lab	0	0	2	0	1	2	
2.	BCSE0282	Full Stack using Node JS Lab	0	0	2	0	1	2	
3.	BCSE0283	Full Stack using C#.net Lab	0	0	2	0	1	2	
4.	BCSE0284	PHP - Scripting Language Lab	0	0	2	0	1	2	
Projects									
1.	BCSE0291	Full Stack Using Scripting Technologies Project	0	0	0	-	2	-	
2.	BCSE0292	Full Stack using Node JS Project	0	0	0	-	2	-	
3.	BCSE0293	Full Stack using C#.net	0	0	0	-	2	-	
4.	BCSE0294	PHP - Scripting Language Project	0	0	0	-	2	-	

BCSE0251: FULL STACK USING SCRIPTING TECHNOLOGIES

Objective: *The objective is to provide a comprehensive study of the frontend. It stresses the strengths of Web, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Hyper Text Mark-up Language (HTML5):** Introduction HTML, HTML Basics, HTML Elements, HTML5 Semantic, HTML Attributes, HTML Headings, HTML Paragraph, HTML Styles, HTML Formatting, HTML Quotations, HTML Computer Code, HTML Comments &Colours, HTML CSS, Links and Images, HTML Lists, HTML Blocks, HTML Classes, HTML Layout, HTML Responsive, HTML iframes, HTML JavaScript, HTML Head, HTML Entities and URI Code, HTML Symbols and XHTML, HTML Charset and Forms **Cascading Style Sheets (CSS3):** Introduction CSS3, CSS3 Syntax, CSS3 How To, CSS3 Colours, CSS3 Backgrounds, CSS3 Boarders, CSS Padding, CSS Height/Width, CSS3 Gradients, CSS3 Shadows, CSS3 Text, CSS3 Fonts, CSS3 2D Transforms, CSS3 3D Transforms, CSS Links, CSS Lists, CSS Tables, CSS Box Model, CSS Outline, CSS Display, CSS Max-width, CSS Position, CSS Float, CSS Inline-block, CSS Align, CSS Combinators, CSS Pseudo-class, CSS Pseudo-element, CSS Navigation Bar, CSS Dropdowns, CSS Tooltips, CSS3 Images, CSS Attr Selectors, CSS Forms, CSS Counters, CSS3 , CSS3 Button, CSS3 Pagination, CSS3 Multiple Columns, CSS3 User Interface, CSS3 Box Sizing, CSS3 Filters, CSS3 Media Queries, CSS3 Responsive	35
II	**JavaScript:** JavaScript Scope, JavaScript Events, JavaScript Strings, JavaScript Numbers, JavaScript Math, JavaScript Arrays, JavaScript Boolean, JavaScript Comparisons, JavaScript Conditions, JavaScript Switch, JavaScript Loops, JavaScript Type Conversion, JavaScript RegExp, JavaScript Errors, JavaScript Debugging, JavaScript Hoisting, JavaScript Strict Mode, JavaScript Functions, JavaScript Objects, JavaScript Forms, JavaScript HTML DOM. **Bootstrap:** Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Bootstrap JS **jQuery**: Introduction to jQuery, jQuery Syntax, jQuery Selectors, jQuery Events, jQuery Effects, jQuery HTML, jQuery Traversing, jQuery AJAX	30

Text Books:

- HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) by DT Editorial Services, 2016
- Learning Web Development with Bootstrap and AngularJS by Stephen Radford,

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After completion of course, student will be able to:

- CO1: Summarize the basics of web development using HTML5, CSS3 and JavaScript.
- CO2: Develop a web page with paragraphs ,divs, images, links, and lists.
- CO3: Develop a web page using CSS IDs and classes
- CO4: Develop JavaScript functions to implement real life problem.
- CO5: Understand the basic concepts of boot strap including grids, themes, CSS and JS.
- CO6: Apply the concepts of jQueries to implement Java Script functions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO3/PSO2
CO2	PO3/PSO2
CO3	PO5/PSO2
CO4	PO4/PSO1
CO5	PO5/PSO4
CO6	PO4/PSO3

BCSE0281: FULL STACK USING SCRIPTING TECHNOLOGIES LAB

Objective: *The objective is to provide a comprehensive study of the frontend. It stresses the strengths of Web, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I/II	• Implements Basic HTML Tags • Implementation of Table Tag. • Implementation Text Formation • Implementation of Links • Implementation of CSS (All 4 Types) • DHTML(Layer/DIV), • Creating Classes in CSS • Use of Selectors, • Implementation of Menu. • Implement of JavaScript Events. • Implement of JavaScript Control Statements. • Implement of JavaScript Function. • Implementation of Responsive Page. • Implementation of Bootstrap Grid. • Implementation of Bootstrap theme. • Implementation of Bootstrap CSS & JS. • Implementation and use JQuery Selectors. • Implementation and use JQuery Events. • Implementation and use JQuery Effects.	12*2=24

Reference Books:

- HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) by DT Editorial Services, 2016
- Learning Web Development with Bootstrap and AngularJS by Stephen Radford

Focus: This Course focuses on Employability,Skill Development and Entrepreneurship under CO1,CO2,CO3,CO5.

Outcomes: After studying the subject, the students will be able to:

- CO1: Implement interactive web page(s) using HTML, CSS and JavaScript.
- CO2: Design a responsive web site using HTML5 and CSS3.
- CO3: Demonstrate Rich Web Applications.
- CO4: Use newer HTML5 tags with associated CSS instructions to organize information and content.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3/PSO1
CO2	PO3/PSO2
CO3	PO1/PSO1
CO4	PO5/PSO4

BCSE0291: FULL STACK USING SCRIPTING TECHNOLOGIES PROJECT

Objective: *The objective is to provide a comprehensive study of the frontend. It stresses the strengths of Web, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits: 02 **L–T–P-J: 0–0–0–0**

Module No.	Content	Lab Hours
I/II	Students Have to develop one Project of Interactive Web Templates. • Ecommerce Template. • E-Learning Template. • Uni. Template. • Photography shop Templates • Service provider Template. • Event planner Template • Model Portfolio Template • Resume Based template • Property Site Template • Educational Site Template • Industry approved and relevant projects	-

BCSE0252: FULL STACK USING NODE JS

Objective: *The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web (Full Stack), which provide students with the means of writing efficient, maintainable, and portable Website.*

Credits: 03 **L–T–P:J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**MongoDB:** Introduction to MongoDB, MongoDB Environment, MongoDB Create Database, MongoDB Drop Database, MongoDB Create Collection, MongoDB Drop Collection, MongoDB Read Operations, MongoDB Write Operations, MongoDB Data Modelling, MongoDB Administration. **Angular JS:** Introduction to AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters, AngularJS Services, AngularJS HTTP, AngularJS Tables, AngularJS Select, Fetching Data from MySQL, AngularJS Validation, AngularJS API. **Express Framework:** Introduction to Express Framework, Introduction to Nodejs, what is Nodejs, Getting Started with Express, Express Routing,	20
II	**Express Framework:** Implementing MVC in Express, Middleware, Using Template Engines, Error Handling, API Handling, Debugging, Developing Template Engines, Using Process Managers, Security & Deployment. **Node.js:** Introduction to Node JS, Setup Dev Environment, Node Core, Node Modules, Creating Web server, File System, Debugging Node JS Application, Automation and Deployment, Events & Database connectivity. **React.js:** Welcome to Starting with React, React Components, React State and Props, React Event Handling, Routing in React React flux, &. Styling React	20

Text Books:

- Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications by Brad Dayley, Brendan Dayley, Caleb Dayley
- Express.js: Guide Book on Web framework for Node.js by Rick L.
- Introduction to React by Cory Gackenheimer,

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After completion of course, student will be able to:

- CO1: Apply programming concepts using Node.Js.
- CO2: Develop web application using MongoDB and AngularJs.
- CO3: Develop web application based on MongoDB.
- CO4: Understand project management and code.
- CO5: Develop RESTful and MVC based web application.
- CO6: Understand the basic concepts of React.js.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO3/PSO2
CO3	PO3/PSO3
CO4	PO2/PSO3
CO5	PO3/PSO2
CO6	PO2/PSO1

BCSE0282: FULL STACK USING NODE JSLAB

Objective: *The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web (Full Stack), which provide students with the means of writing efficient, maintainable, and portable Website.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I/II	• Installing and Managing MogoDB. • Create & Manage Database. • Create & Manage collections • Implementation of Modeling. • Create your first AngularJS application in Visual Studio. • Build a shopping cart using AngularJS • Implementation AngularJS Expressions • Implementation AngularJS Modules • Implementation AngularJS Events • Implementation AngularJS Filters & Services • Node JS- Setup Dev Environment. • Express Routing • Implementing MVC in Express. • Implementing Template Engines. • Implementing Node Modules, • Implementing React Components, • Implementing React Event.	12*2=24

Reference Books:

- Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications by Brad Dayley, Brendan Dayley, Caleb Dayley
- Express.js: Guide Book on Web framework for Node.js by Rick L.
- Introduction to React by Cory Gackenheimer,

Focus: This Course focuses on Employability, Skill Development and Entrepreneurship under CO1,CO2,CO3.

Outcomes: After studying the subject, the students will be able to:

- CO1: Implement web application using MongoDB and Angular.Js.
- CO2: Develop web application using NodeJs.
- CO3: Develop RESTful and MVC based web application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO5/PSO2
CO2	PO3/PSO2
CO3	PO5/PSO4

BCSE0292: FULL STACK USING NODE JS PROJECT

Objective: *The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web (Full Stack), which provide students with the means of writing efficient, maintainable, and portable Website.*

Credits: 02 **L–T–P-J: 0–0–0–0**

Module No.	Content	Lab Hours
I/II	Students Have to develop one Project of Interactive Web Templates. • Ecommerce Template. • E-Learning Template. • Uni. Template. • Photography shop Templates • Service provider Template. • Event planner Template • Model Portfolio Template • Resume Based template • Property Site Template • Educational Site Template • Industry approved and relevant projects	-

BCSE0253: FULL STACK USING C#.NET

Objective: *The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web (Full Stack), which provide students with the means of writing efficient, maintainable, and portable Website.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**.NET Framework & C#:** Expressions & Primitive Types, Non-Primitive Types, Control Flow, Arrays & Lists, Date & Time, Text, File System, Debug Application, Classes, Association, between Classes, Inheritance - Second Pillar of OOP, Polymorphism: Third Pillar of OOP, Interfaces, C# Advanced Topics & ADO.net. **Collections and Generics:** Introducing Collections, Benefits of Collection Classes, Understanding and using commonly used collections, Generics, Advantages of Generics, Generic Collections **ASP.NET Core:** Introduction to ASP.NET Core, ASP.NET Core First Application, - Controllers & Action Methods, Views, Helpers, Model Binding, - Validations & Data Annotations, State management Techniques, Security, MVC and Entity Framework Core, ASP.NET Core - Web Caching, Routing, Module Development & Web API and JQuery Ajax, Creating a Layout Using Master Pages&, Data bound Controls.	20
II	Mic**rosoft SQL Server:** Introduction to Basic Database Concepts, Introduction to SQL, Introduction to SQL, Joins and Set Operations, Working with Stored Procedures and Functions, Transaction Control Language (TCL) & Backup/Restore. **Angular JS:** Introduction to AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters, AngularJS Services, AngularJS HTTP, AngularJS Tables, AngularJS Select, Fetching Data from MySQL, AngularJS Validation, AngularJS API. **React.js:** Starting with React, React Components, React State and Props, React Event Handling, Routing in React flux, &. Styling React	20

Text Books:

- Learning Angular for .NET Developers by Rajesh Gunasundaram
- ASP.NET Core Application Development - Building an Application in Four Sprints by James Chambers, David Paquette, Simon Timms
- Querying Microsoft SQL Server 2012 Exam 70-461 Training Kit by Gan B.I
- Introduction to React by Cory Gackenheimer,

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After completion of course, student will be able to:

- CO1: Understand the basic programming concepts of C#.
- CO2: Develop web application using Asp.Net Core.
- CO3: Understand the basic concepts of SQL server.
- CO4: Develop web application Using Angular JS.
- CO5: Develop RESTful and MVC based web application.
- CO6: Understand the basic concepts of React.js.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO3/PSO4
CO3	PO5/PSO1
CO4	PO3/PSO4
CO5	PO3/PSO4
CO6	PO5/PSO4

BCSE0283: FULL STACK USING C#.NET LAB

Objective: *The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web (Full Stack), which provide students with the means of writing efficient, maintainable, and portable Website.*
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Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I/II	• WAP to Implement Types in C# • WAP to Illustrate Control Flow Statements • Implements Array and lists • WAP to Read write in files. • Implements Inheritance • Implements Interface • Create a data access layer with Entity Framework Core 2 • Initialize data for testing with EF Core 2 • Build a website with ASP.NET Core 2 • Configure the HTTP pipeline and routing • Creating Tag Helpers • Create and use View Components • create your first AngularJS application in Visual Studio. • Build a shopping cart using AngularJS • Implementation AngularJS Expressions • Implementation AngularJS Modules • Implementation AngularJS Events • Implementation AngularJS Filters & Services • Implementing React Components, • Implementing React Event.	12*2=24

Reference Books:

- Learning Angular for .NET Developers by Rajesh Gunasundaram
- ASP.NET Core Application Development - Building an Application in Four Sprints by James Chambers, David Paquette, Simon Timms
- Querying Microsoft SQL Server 2012 Exam 70-461 Training Kit by Gan B.I
- Introduction to React by Cory Gackenheimer,

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.
Outcomes: After studying the subject, the students will be able to:

- CO1: Implement the basic programming concepts of C#.
- CO2: Develop web application using Asp.Net Core.
- CO3: Develop web application using Angular.JS.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO3/PSO4
CO3	PO3/PSO4

BCSE0293: FULL STACK USING C#.NET PROJECT

Objective: *The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web (Full Stack), which provide students with the means of writing efficient, maintainable, and portable Website.*

Credits: 02 **L–T–P-J: 0–0–0–0**

Module No.	Content	Lab Hours
I/II	Students Have to develop one Project of Interactive Web Templates. • Ecommerce Template. • E-Learning Template. • Uni. Template. • Photography shop Templates • Service provider Template. • Event planner Template • Model Portfolio Template • Resume Based template • Property Site Template • Educational Site Template • Industry approved and relevant projects	-

BCSE0254: PHP - SCRIPTING LANGUAGE

Objective: *The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web, which provide students with the means of writing efficient, maintainable, and portable Website*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**PHP Basics:** Introduction to PHP, Basic Syntax of PHP, Embedding PHP in HTML, Comments, Variables, Constants, Managing Variables, Operators and Operator Precedence and String Manipulation functions. **Conditional Control Structures:** If statement, If- else statement, If- else if statement, Nested If, Switch statement. **Functions in PHP:** Functions, User-Defined function, Call by value and call by references, Understanding variable scope, Global Variables, Static Variables, Include and Require, Built-in functions in PHP. **Arrays:** Arrays and its types in PHP, Accessing Elements of an Array, Modifying Elements of an Array, Functions in array, Array Sorting, Multidimensional Array. **PHP File Handling:** Introduction, File Open, File Creation, writing to files, reading from File, searching a record from a file, Closing a File.	20
II	**Class and Object:** Introduction, Object, Class, Defining Class in PHP, Object in PHP, Usage of this variable, Constructor, Constructor with Parameters. **Exception Handling:** Introduction to Exception, Exception Handling mechanisms, Creating Custom Exceptions, Multiple Catch Blocks, Exception Propagation, Error Handling in PHP. **Form Handling and Session Management in PHP:** Accessing and displaying Form data from different Form components, Differences among $_GET, $_POST and $_REQUEST variables, Session management, Session operations, Session tracking mechanism, Clearing/Modifying data from session, destroying a session, Setting and Retrieving Cookies, uploading a file, displaying its details, restricting various details of a file during upload, checking for errors and reading Error code table. **Database Management:** Introduction to DBMS, SQL Basics, Database connectivity in PHP with MySQL, Executing Queries from frontend. **XML:** Introduction to XML, Parsing XML document using DOM parser, Various operations on XML document using PHP.	20

Text Books:

- PHP Reference Beginner to Intermediate PHP 5 By Mario Lurig
- PHP and MySQL by Mike McGrath,

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After completion of course, student will be able to:

- CO1: Explain the basics of web development using PHP and HTML.
- CO2: Develop a program using control structures and array.
- CO3: Develop the PHP programs based on functions, and file handling.
- CO4: Demonstrate the concepts of object and exception handling in PHP.
- CO5: Demonstrate web application using PHP, CSS and MYSQL on XAMPP/WAMP framework.
- CO6: Develop a dynamic/ static websites with server side programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO4,PO12/PSO1
CO3	PO1,PO3,PO8/PSO1
CO4	PO4,PO7,PO8/PSO3
CO5	PO2,PO3,PO7,PO9/PSO3
CO6	PO6,PO9,PO11,PO12/PSO3,PSO4

BCSE0284: PHP - SCRIPTING LANGUAGE LAB

Objective: *The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web, which provide students with the means of writing efficient, maintainable, and portable Website.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I/II	• Creating simple webpage using PHP • Use of conditional statements in PHP • Use of looping statements in PHP • Creating different types of arrays • Usage of array functions • Creating user defined functions • Creation of files • File manipulation using PHP • Creation of sessions • Creation of cookies • Creating simple table with constraints • Insertion, Updating and Deletion of rows in MYSQL tables • Searching of data by different criteria • Usage of aggregate functions • Working with string, numeric and date functions • Database connectivity in PHP with MySQL • Validating Input	12*2=24

Reference Books:

- PHP Reference Beginner to Intermediate PHP 5 By Mario Lurig
- PHP and MySQL by Mike McGrath,

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After studying the subject, the students will be able to:

- CO1: Implement the basic constructs using PHP.
- CO2: Develop web application using PHP.
- CO3: Develop RESTful and MVC based web applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO6/PSO1,PSO2
CO2	PO5,PO7,PO8/PSO3,PSO4
CO3	PO3,PO11,PO12/PSO4

BCSE0294: PHP - SCRIPTING LANGUAGE PROJECT

Objective: *The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web, which provide students with the means of writing efficient, maintainable, and portable Website.*

Credits: 02 **L–T–P-J: 0–0–0–0**

Module No.	Content	Lab Hours
I/II	Students Have to develop one Project of Interactive Web Templates. • Ecommerce Template. • E-Learning Template. • Uni. Template. • Photography shop Templates • Service provider Template. • Event planner Template • Model Portfolio Template • Resume Based template • Property Site Template • Educational Site Template • Industry approved and relevant projects	-

BCSE0255: DIGITAL MARKETING AND TRANSFORMATION

Objective: *The objective of this course is to provide knowledge about the digital marketing and the industry trends correspondence to the concepts*.

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Lab Hours
I	**Introductionto Digital Marketing** Modern Marketing- How Marketing Works, Fundamentals Channels- Awareness, Consideration & Decision Making, Building Integrated Marketing Plan, Lead Journey- From Prospect to Sales. **Website and Blogging** The Power of Storytelling, Know Your Customer - Market and Content Research, Construct Prospective Buyer Personas & Journeys, Establishing The Content Ideation & Creation Framework, Creative Design Principles, Linking Blogs To Social Network (Conversation Blogs), Measuring And Optimizing Blog Performance, Importance Of Responsive Design, Leverage Landing Pages And Forms To Accelerate Conversion. **Content Promotion** SEO as an Art and as a Science, Ranking Algorithms, Website Audit, Optimizing Digital Assets & Metadata, Decoding Common Paid Media Platforms, Influencer Marketing, Black Hat, White Hat and Grey Hat SEO **Email Marketing** Types of Email (Promo/Trans/NL), ESP Setup & On-boarding, Permission Marketing, Subscriber welcome plan and journey, List segmentation and Management, Personalization and Responsive design, Multivariate Testing, E-commerce Integration, Deliverability and System Reputation Management, System Integrations & Automations.	20
II	**Social Media Marketing** Social Ads Type and their Design Structure, targeting strategy and planning – Laser/Broad, Effective targeting and custom audience set-up, Campaign setup and reporting on various social platforms, Social Split Advertising, Content Calendar, Peremptory traits for Social Advertising PPE, WC and CTW campaigns. **Mobile Marketing** Mobile landscapes for Marketing and Monetization, Conventional Advertising, Millennial Mobile Advertising, Versatile Promotions, Alternative focusing and promotions on Mobile, Push App and Game based promotions, Location evolution with mobile **Marketing Analytics & ROI** Key marketing engagement & ROI metrics, Primer on data science and analytics concepts, Web Traffic nuances, Multi-channel Analytics, Decoding CLV and RFM, Deciphering conversion and goal metrics, implement conjoint analysis & decision tree tactics, Avoiding common analytical pitfalls.	20

Text Book:

- Puneet Singh Bhatia, Fundamentals of Digital Marketing First Edition, Publication Pearson.

Reference Books:

- Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted and Measurable Online Campaigns, Publication Wiley India Pvt Ltd.

- Philip Kotler, HermawanKartajaya, IwanSetiawan, Marketing 4.0: Moving from Traditional to Digital, , Publication Wiley India Pvt Ltd.
- Vandana Ahuja, Digital Marketing 1st Edition, Publication Oxford.
- Rohan Yamagishi, Digital Marketing in Asia: A Start-Up Guide for Search Engine Marketing in APAC, Publication R. R. Bowker

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcomes: After learning the course the students should be able to:

- CO1: Understanding the basics of digital marketing.
- CO2: Explain the measurement techniques used in evaluating digital marketing efforts.
- CO3: Understand the use of digital marketing for multiple goals within a larger marketing and media strategy.
- CO4: Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, and social media.
- CO5: Explore the latest digital ad technologies.
- CO6: Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO4,PO7,PO8/PSO1
CO2	PO1,PO4,PO7,PO8/PSO1
CO3	PO1,PO7,PO8/PSO1
CO4	PO1,PO7,PO8/PSO1
CO5	PO1,PO7,PO8/PSO3
CO6	PO1,PO4,PO7,PO8/PSO4

COURSE STRUCTURE

B.TECH.

COMPUTER SCIENCE & ENGINEERING

Specialization

in

Cyber Security And Forensics

Under

Choice Based Credit System (CBCS)

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Program Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals, researchers or entrepreneurs, for developing sustainable solutions.

PEO2: Attain positions of leadership in an organization and /or on teams.

PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Program Specific Outcomes (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.

PSO2: Design and develop hardware and software interfaces along with latest tools and technology to meet the needs of industry.

PSO3: Analyze the algorithmic principles, theory of computation, applied database management systems and mathematical foundations for the modeling and design of computing systems.

PSO4: Apply knowledge to provide innovative solutions to existing problems and identify research gaps.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics and science, with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE.

PO2: Problem Analysis: Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of solutions: Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations.

PO4: Conduct Investigations of Complex problems: Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development

PO8: Ethics: Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

PO12: Life-Long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change.

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BPHS1001	Engineering Physics	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication – I	2	0	0	2	2
4.	BEEG0001	Electrical Engineering	3	1	0	4	4
5.	BCSG0001	Python Programming	4	1	0	5	5
6.	BCSC0602	Information Security Fundamentals	2	0	0	0	2
PRACTICALS							
7.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
8.	BELH0801	English Language Lab – I	0	0	2	1	2
9.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
10.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
11.	BCSG0800	Python Programming Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**26**	**31**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BCSC 1001	C PROGRAMMING	3	1	0	4	4
3.	BELH0002	English Language Skills for Communication – II	2	0	0	2	2
4.	BECG0001	Electronics Engineering	3	1	0	4	4
5.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
6.	BCSC0603	IT Systems Security and Physical Security	3	0	0	3	3
PRACTICALS							
7.	BCSC 0800	C PROGRAMMING Lab	0	0	2	1	2
8.	BELH0802	English Language Lab – II	0	0	2	1	2
9.	BECG0800	Electronics Lab I	0	0	2	1	2
10.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1	2
11.	BCSC0900	IT Systems Security and Physical Security Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**26**	**31**

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME	CRE DITS	CON TAC	PRE- REQUISITES

			L	T	P	J			
THEORY									
1.	BCSC1001	Computer Programming	3	1	0	0	4	4	
2.	BCSC0002	Object Oriented Programming	3	0	0	0	3	3	Computer Programming
3.	BCSC0003	Database Management System	3	0	0	0	3	3	
4.	BCSC0004	Operating Systems	3	0	0	0	3	3	
5.	BCSC0005	Computer Organization	3	0	0	0	3	3	
6.	BCSC0006	Data Structures & Algorithms	3	1	0	0	4	4	Computer Programming
7.	BCSC0007	Introduction to Microprocessors	3	0	0	0	3	3	Computer Organization
8.	BCSC0008	Computer Networks	3	1	0	0	4	4	
9.	BCSC0009	Software Engineering	3	0	0	0	3	3	
10.	BCSC0010	Discrete Mathematics	3	1	0	0	4	4	
11.	BCSC0011	Theory of Automata & Formal Language	3	1	0	0	4	4	
12.	BCSC0012	Design and Analysis of Algorithm	3	1	0	0	4	4	Data Structures & Algorithms
13.	BCSC0602	Information Security Fundamentals	2	0	0	0	2	2	
14.	BCSC0603	IT Systems Security and Physical Security	3	0	0	0	3	3	
15.	BCSC0014	Applied Database Management System	4	0	0	0	4	4	
PRACTICALS									
1.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
2.	BCSC0801	Object Oriented Programming Lab	0	0	2	0	1	2	Programming Lab
3.	BCSC0802	Database Management System Lab	0	0	2	0	1	2	
4.	BCSC0803	Operating Systems Lab	0	0	2	0	1	2	
5.	BCSC0804	Computer Organization Lab	0	0	2	0	1	2	
6.	BCSC0805	Data Structures & Algorithms Lab	0	0	2	0	1	2	Programming Lab
7.	BCSC0806	Microprocessors Lab	0	0	2	0	1	2	Computer Organization Lab
8.	BCSC807	Design and Analysis of Algorithms	0	0	2	0	1	2	
9.	BCSC0901	IT Systems Security and Physical Security Lab	0	0	2	0	1	2	
10.	BCSC0808	Applied Database Management System	0	0	2	0	1	2	
		Total	**45**	**6**	**20**	**0**	**61**	**71**	

Program Elective (Only for Specialization Programme)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Cyber Security and Forensics									
THEORY									
1.	BCSE0601	IT Application and Data Security	3	0	0	0	3	3	
2.	BCSE0602	IT Network Security	3	0	0	0	3	3	
3.	BCSE0603	Information Security Audit & Monitoring	2	0	0	0	2	2	
4.	BCSE0604	Cloud Architecture and Deployment Models	3	0	0	0	3	3	
5.	BCSE0605	IT business Continuity & Disaster Recovery	2	0	0	0	2	2	
6.	BCSE0606	Digital Forensics	3	0	0	0	3	3	
7.	BCSE0607	Ethical Hacking and Penetration Testing	2	0	0	0	2	2	
PRACTICALS									
1.	BCSE0631	IT Application and Data Security Lab	0	0	2	0	1	2	
2.	BCSE0632	IT Network Security Lab	0	0	2	0	1	2	
3.	BCSE0633	Information Security Audit & Monitoring Lab	0	0	2	0	1	2	
4.	BCSE0634	Cloud Architecture and Deployment Models Lab	0	0	2	0	1	2	
5.	BCSE0635	Digital Forensics Lab	0	0	2	0	1	2	
6.	BCSE0636	Ethical Hacking and Penetration Testing Lab	0	0	2	0	1	2	
		TOTAL	**18**	**0**	**12**	**0**	**24**	**30**	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BCSJ0950	Mini Project – I	0	0	0	0	2	0	
2.	BCSJ0951	Mini Project – II	0	0	0	0	2	0	
3.	BCSJ0971	Project – Part I	0	0	0	0	3	0	
4.	BCSJ0972	Project – Part II	0	0	0	0	8	0	
5.	BCSJ0991	Industrial Training	0	0	0	0	2	0	
		TOTAL	**0**	**0**	**0**	**0**	**17**	**0**	

Mandatory Non Graded Course

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
5.	BCHM0202	Environmental Studies	2	0	0	0	2	2	
6.	BELM0001	Introduction to Bhagavad Gita	2	0	0	0	2	2	
		TOTAL	**12**	**0**	**0**	**0**	**0**	**12**	

Humanities and Social Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purposes – I	2	0	0	0	2	2	
4.	BELH0004	English for Professional Purposes – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAH0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	8	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	8	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG0001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BCSG0001	Python Programming	4	1	0	0	5	5	
PRACTICALS									
5.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
6.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
7.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
8.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
9.	BCSG0800	Python Programming Lab	0	0	2	0	1	2	

BCSG0001: PYTHON PROGRAMMING

Objective: *This course introduces the solving of mathematical problems using Python programming using OO concepts and its connectivity with database.*

Credits:05 **L-T-P-J:4-1-0-0**

Module No.	Content	Teaching Hours
I	Introduction to Python: Introduction and Basics; Setting up path Python Data Variables & Operators: Data Variables and its types, id () and type () functions, Coding Standards; **Control Structures:** if-else, elif, Nested if, Iteration Control structures, Break, Continue & Pass; **String Manipulation:** Accessing Strings, Basic Operations, String slices Function and Methods. **Lists:** Introduction, Accessing list, Operations, Working with lists, Function and Methods. **Tuple:**Introduction, accessing tuples, Operations, Working, Functions and Methods. **Dictionaries:** Introduction, accessing values in dictionaries, Working with dictionaries, Properties,Functions.	22
II	**Functions:** Defining & Calling a function, Passing arguments to functions – Mutable & Immutable Data Types, Different types of arguments, Recursion, Scope of variables; **Modules and Packages:** User-defined modules and Standard Library: random, numpy, scipy, sys, Math Module, String Module, List Module, Date & Time Module, Regular Expressions: match, search, replace; **Input-Output:** Printing on screen, reading data from keyboard, Opening and closing file, Reading and writing files, Functions. **Exception Handling:** Exception, Exception Handling, except clause, try? finally clause, User Defined Exceptions. Basics of Python for Data Analysis, Introduction to series and dataframes & Python using Pandas.	22

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of Python Programming.
- CO2: Apply the concepts of control structures and string manipulations of python programming.
- CO3: Understand the use of data structures available in Python List, Tuple and Dictionary.
- CO4: Experiment user-defined functions and access built-in functions.
- CO5: Experiment user-defined modules and access built-in modules- math, random, string, date, time, date time.
- CO6: Develop the programs using the concept of File Handling.
- CO7: Develop programs based on Exceptional Handling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO4
CO2	PO4/PSO1
CO3	PO5/PSO4
CO4	PO5,PO7/PSO1
CO5	PO2,PO8/PSO4
CO6	PO3,PO10/PSO2
CO7	PO5,PO9/PSO1

BCSC1001: COMPUTER PROGRAMMING

Objective: *To impart adequate knowledge on the need of problem solving techniques and develop programming skills to implements applications using the concepts of C Language. Also by learning the programming constructs they can easily switch over to any other language in future.*

Credits:05 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Generation of Programming Languages:** Low, Assembly, High and 4GL. **Language Processors:** Compiler, Interpreter, Assembler, Linker and Loader. **Algorithm:** Introduction, Features, Different Ways of stating Algorithms. **Flow Chart:** Introduction, Standard, Guidelines, Advantages and Limitations of using Flowcharts. **Basics of C:** Overview, Structure of a C program, Identifier, Keywords, Variables, Data types, Formatted Input and output. **Operators and Expression:** Assignment, Unary, Arithmetic, Relational, Logical, Bitwise, Conditional, Special operators and their precedence & Associativity. IEEE representation of data types like float & double, Lvalue and Rvalue **Type Conversion:** Type Promotion in expression, Conversion by Assignment, Truncation and Casting Arithmetic expression. **Decision and Case Control Structure:** if, if-else, nested if-else, Decisions using switch, switch versus if-else ladder, goto. **Loop Control Structure:** For loop, while loop, do-while loop, nesting of loops, break, and continue. **Arrays:** Introduction, one-dimensional and two-dimensional Array-Declaration, Initialization, Address Calculation. **Operations on Arrays:** Insertion, Deletion, Linear Search & Bubble Sort. **String:** Introduction, One dimensional and two dimensional Array-Declarations, Initialization **Operations on String:** Length, Copy, Reverse, Concatenate, Compare with & without built-in functions.	25
II	**Functions:** Declaration and Definition, Category of Functions, Parameter Passing Techniques – Call by Value, Passing Arrays to Functions. **Introduction to Storage Classes:** Auto, Static, Extern and Register. **Recursion:** Mechanics of Recursive Call, Implementation of Recursion, Recursion vs. Iteration. **The C Preprocessor:** Introduction, Macro Expansion and File Inclusion, Conditional Compilation and Miscellaneous Directives. **Pointers:** Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Arrays and Pointers, Pointer and Strings, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointer to an Array, Two Dimensional Array and Pointers, Pointers to Functions, Dynamic Memory Allocation, void Pointer and Null Pointer. **User Defined Types:** enum, typedef, Union and Structure - Declaration, Initialization, Nested Structures, Arrays of Structures, Structure and Pointer, Passing Structure Through Function. Difference between Structures and Union. **File Handling:** Data and Information, File Concepts, File Organization, File Operations: Open, Read, and Close, Trouble in Opening a File. File Opening Modes, Working with Text Files. Random Access to Files of Records. Introduction to Command Line Arguments.	25

Text Books:

- Behrouz A. Forouzan and Richard F. Gilberg, "Computer Science – A Structured Programming Approach Using C", C Language Learning, 2007

Reference Books:

- Herbert Schildt, "C: The Complete Reference", 5th Edition, McGraw Hill Education
- K. N. King, "C Programming a Modern Approach", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, "The C Programming Language", PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of problem solving skills.
- CO2: Apply the basic principles of programming in C language.
- CO3: Understand the concepts of arrays and strings in C language.
- CO4: Apply the concepts of functions to solve real world problems.
- CO5: Illustrate the concepts of recursion.
- CO6: Understand the concepts of pointers in C language.
- CO7: Understand the basic concepts of file handling.
- CO8: Develop algorithmic solutions to simple computational problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO10/PSO1,PSO3
CO3	PO1,PO2,PO3,PO4/PSO1,PSO3
CO4	PO1,PO3, PO12/PSO1,PSO2
CO5	PO1,PO2,PO4 /PSO1,PSO3
CO6	PO1,PO2,PO3,PO4/PSO1,PSO2
CO7	PO1,PO3,PO6 /PSO1
CO8	PO1,PO2,PO4,PO10,PO12/PSO1,PSO3

BCSC0002: OBJECT ORIENTED PROGRAMMING

OBJECTIVE: *This course introduces the Object-Oriented programming paradigm to students. It also teaches a student how to think objectively and model a Java program for solving real-world problems.*

CREDITS: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Object-Oriented Programming:** Features of Object-Oriented Programming, Introduction to Object-Oriented Java Programming. **g Java Technology & Environment:** Understanding the compilation process of the JVM, JVM vs JDK vs JRE, Key Features of Java, Structure of a simple Java program. **Working with Java Primitive Data Types:** Strongly Typed nature of Java, Primitive Data Types in Java, The new 'var' keyword, Scope of a variable. **Accepting User Input in Java Programs:** using the Scanner class, using command line arguments. **Programming Constructs:** Sequence, Selection, Iteration & Transfer Statements, For-Each Loop. **Working with Java Arrays**: Declaring and Initializing One-Dimensional and Two-Dimensional Arrays in Java, Introduction to java. util. Arrays class. **The String API:** String Data Type, commonly used methods from the String API, StringTokenizer , StringBuilder & StringBuffer. **Creating and Using Methods:** Signature of a method, Types of Methods, Overloading methods in a class, Static and Non-Static Methods. **Describing and Using Objects & Classes:** Declare the structure of a Java class, declaring members of a class (fields and methods), declaring and using Java Objects, lifecycle of an Object (creation, assignment, dereferencing and garbage collection), Constructors of a class, Overloading Constructors, Constructor chaining using 'this' and 'super' keyword. **Using Java Packages:** create and import Java packages and static imports, abstracting program logic to packages, creating executable main class, running the executable class inside a package. **Applying Encapsulation**: Using access modifiers with/in a class, principles of encapsulation. **Programming Abstractly Through Interfaces:** create and implement Interfaces for programs, private and default methods in Interfaces, declaring Abstract Classes, Constructors in Abstract Classes. Marker Interface, Functional Interfaces, Lambda Expressions in Java.	20
II	**Reusing Implementations using Inheritance:** Declaring Subclasses and Superclasses, extend Abstract Classes, implementing Interfaces, exploring polymorphic behaviour by overriding methods, Object Types vs Reference Types, differentiate overloading, overriding and hiding. **Exception Handling:** Exception Hierarchy, Need of Exception Handling, Checked Exceptions, Unchecked Exceptions and Errors, Try-Catch Blocks, Finally, Throw & Throws Keywords, creating and handling Custom Exceptions. **Threads in Java:** Life Cycle of a Thread, creating threads using Runnable and Thread, 'sleep ()', Thread Priorities. **Using Wrapper Classes:** Wrapper Classes in Java, Boxing-Unboxing-Auto Boxing-Auto Unboxing. **Generics & Collections:** Creating Generic classes, Generic Methods, Diamond Notation, Wildcards, Type Erasure, Collection Hierarchy, Base Interfaces, Lists, Sets and Maps. **The Stream API:** Introduction to the Stream API, using lambda expressions in Streams. **Regular Expressions:** Pattern and Matcher Class.	18

	JDBC: JDBC Drivers, Connecting to a MySQL Database, DriverManager, Connection Interface, Statement Interface, Result Set Interface, Prepared Statements.	

Text Book:
- Herbert Schildt , "The Complete Reference, Java Eleventh Edition", Oracle Press, 2019.

Reference Book:
- Cay S Hosrtmann , "Core Java Volume I—Fundamentals, Eleventh Edition", Pearson, 2018.
- Rogers Cadenhead , "Sams Teach Yourself Java in 21 Days (Covers Java 11/12), 8th Edition", Pearson, 2020.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO8.

Outcome: After completion of the course, students will be able to -
- CO1: Understand the basics of Object-Oriented Programming paradigm.
- CO2: Construct the logical flow of programs by using the sequence, selection, iterations and transfer statements.
- CO3: Apply the concepts of Object- Oriented Programming to model programs in Classes, Abstract Classes, Interfaces and Enums, and simplify program function by dissecting it into methods.
- CO4: Understand accessibility of members in a program unit and create packages to prevent namespace collisions.
- CO5: Predict run-time errors in a program by examining program functioning.
- CO6: Show the parallel processing capabilities of a program using a multithreading concept.
- CO7: Experiment with the predefined classes and interfaces defined in the Collections Framework.
- CO8: Develop a program using JDBC connectivity to demonstrate data persistence.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1 /PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/ PSO2
CO7	PO1,PO2,PO11/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO2

BCSC0003: DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database & NoSQL system. Students learn how to design and create a good database.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System Vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with Case Studies. Data Modeling Using the Entity-Relationship Model**:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. Relational Data Model and Language**:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization I:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, Non-Redundant Cover, Canonical Cover **PL/SQL:** Query languages, nested queries, group by and having clause.	20
II	**Database Design & Normalization II:** 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, MVD and JDs, Inclusion Dependence. **File Organization:** Indexing, Structure of Index files and Types, Dense and Sparse Indexing **Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data	20

Text Books:

- Elmasri and Navathe , "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.

- Redmond, E. & Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1,CO2,CO6.

Outcome: After the completion of the course, the student will:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss indexing mechanisms for efficient retrieval of information from a database.
- CO8: Discuss recovery system and be familiar with introduction to web database, distributed databases.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1 /PSO1
CO2	PO2, PO3/ PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3,PO9/ PSO2
CO7	PO1,PO11 /PSO1
CO8	PO1,PO3,PO12/ PSO2

BCSC0004: OPERATING SYSTEMS

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Operating System and its Classification - Batch, Interactive, Multiprogramming, Time sharing, Real Time System, Multiprocessor Systems, Multithreaded Systems, System Protection, System Calls, Reentrant Kernels, Operating System Structure- Layered structure, Monolithic and Microkernel Systems, Operating System Components, Operating System Functions and Services. **Processes:** Process Concept, Process States, Process State Transition Diagram, Process Control Block (PCB), Process Scheduling Concepts, Threads and their management. **Process Synchronization:** Principle of Concurrency, Implementation of concurrency through fork/join and parbegin/parend, Inter Process Communication models, shared memory and message passing Schemes, Producer / Consumer Problem, Critical Section Problem, race condition ,two process software solution Dekker's solution, Peterson's solution, Semaphores, Synchronization Hardware. **Classical Problem in Concurrency:** Dining Philosopher Problem, Readers Writers Problem, sleeping barbar,	20
II	**Deadlock:** System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock, Combined Approach. **Memory Management:** Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation. **Virtual memory concepts:** Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Locality of reference. **I/O Management and Disk Scheduling:** I/O devices, I/O subsystems, I/O buffering, Disk storage and disk scheduling. **File System:** File concept, File organization and access mechanism, File directories, File allocation methods, Free space management.	20

Text Books:

- Silberschatz, Galvin and Gagne , "Operating Systems Concepts",9th Edition, Wiley, 2012.

Reference Books:

- Sibsankar Halder and Alex a Aravind ," Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1,CO2,CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the classification of operating system environment.
- CO2: Understand the basic of process management.
- CO3: Apply the concept of CPU process scheduling for the given scenarios.
- CO4: Illustrate the process synchronization and concurrency process in operating system.
- CO5: Analyze the occurrence of deadlock in operating system.
- CO6: Describe and analyze the memory management and its allocation policies.
- CO7: Understand the concepts of disk scheduling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO4/PSO1,POS3
CO4	PO3,PO4,PO6/PSO3,PSO4
CO5	PO1,PO4/PSO1,PSO3
CO6	PO1,PO2 /PSO1,PSO3
CO7	PO1,PO2,PO7/PSO1,PSO3

BCSC0005: COMPUTER ORGANIZATION

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**PREAMBLE:** Subject Introduction, Basic organization of the computer and block level description of the functional units, Number Representation, Fixed and floating-point Number Representation-Arithmetic Addition/subtraction, overflow, IEEE standard for floating point representation, **Basic Computer Organization and Design:** Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description. Introduction to combinational circuit - Half Adder, Full Adder, carry look ahead adder, Multiplexor/ De multiplexer and Decoder/Encoder, Introduction to sequential circuit- Flip-Flops, Synchronous and Asynchronous Counters, Register, Bus and memory Transfer Language. **Arithmetic Operations:** Addition and subtraction of signed numbers, Hardware implementation of Method, Multiplication: Signed operand multiplication, Booths algorithm, Hardware implementation of Algorithms, Array Multiplier. **Processor Organization:** General register organization, Single Accumulator and Stack organization, Addressing Modes, Types of Computer Instructions – one, two, three & four address, Instruction Cycle, Instruction Formats.	20

II	**Micro-operations:** Arithmetic, Logical & Shift Micro operations with some applications. **Multiprogramming and Multiprocessing:** Introduction to pipelined operation. **Hardwired & Microprogrammed Unit:** Execution of a complete instruction & Branch Instructions, Hardwired control Unit, Micro programmed control Unit, Micro-Instructions, Microinstruction with Next Address field, Pre-Fetching Microinstructions, Concept of Horizontal and Vertical Microprogramming. **Memory:** Basic concept and Hierarchy, RAM memories, 2D, 2 & 1/2D Memory Organization, ROM Memories, Cache Memories: Concept and Design issues performance, Address mapping and Replacement, Auxiliary memories: Magnetic disk, Magnetic tape and Optical disks, Virtual memory: Concept and Implementation. Input/Output: Peripheral Devices, I/O interface, I/O ports. **Interrupts:** Interrupt hardware, Types of Interrupts and Exceptions, Buses, Bus architecture, Types of Buses and Bus Arbitration. Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O, Direct Memory Access, I/O channels and Processors, Standard communication interfaces.	**20**

Text Books:

- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4th**Edition**, Elsevier Publication, 2008.
- William Stalling , "Computer Organization",8th Edition, PHI, 2011.
- V. CarlHamacher, Zaky , "Computer Organization",4th International Edition, TMH, 1996.
- John P Hays, "Computer Organization", 2nd Edition, TMH.
- Tannenbaum , "Structured Computer Organization", 5thEdition, PHI, 2005.
- P Pal Chaudhry , "Computer Organization & Design", 2ndEdition, PHI, 2002.

Focus: This Course focuses on Employability under CO1,CO2,CO5,CO8.

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the basics of digital computer system.
- CO2: Demonstrate the principle of arithmetic operations on unsigned, signed integers and floating point numbers.
- CO3: Understand the concepts of Combinational and Sequential circuits and their applications.
- CO4: Understand the CPU architecture and organization.
- CO5: Explain the basic concepts of pipelining.
- CO6: Design the steps for the execution of the complete instruction for hardwired and micro-programmed control unit.
- CO7: Explain the function of memory hierarchy.
- CO8: Determine the interface of CPU with input/output devices and their modes of transfer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO1,PO3/PSO1
CO3	PO2,PO3,PO5/PSO2
CO4	PO2,PO3,PO4/PSO1,PSO3

CO5	PO2,PO3,PO4/PSO2
CO6	PO1,PO2,PO3/PSO1,PSO3
CO7	PO2,PO3,PO5/PSO2,PSO3
CO8	PO3,PO4/PSO1

BCSC0006: DATA STRUCTURES AND ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs*.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Terminology, Elementary Data Organization, Properties of an Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic Notations – Big-Oh; Operations on Data Structure, Abstract Data Types (ADT). **Linked Lists:** Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Generalized Linked List, Polynomial Representation and Addition. **Stacks:** Primitive Stack Operations - Push & Pop, Array and Linked Implementation of Stack in C, Application of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of Infix to Postfix expression, Recursion, Principles of Recursion, Tail Recursion, Removal of Recursion, use of stack in Recursion, Tower of Hanoi Problem. **Queues:** Operations on Queue - Add, Delete operations, Implementation of Queue Using Array and Linked List, Circular Queues, Deque and Priority Queue. **Trees:** Basic Terminology, Array Representation and Dynamic Representation; Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Tree Traversal Algorithms - Inorder, Preorder and Postorder; Threaded Binary Trees, Traversing Threaded Binary Trees.	20
II	**Search Trees:** Binary Search Trees (BST), Insertion and Deletion in BST, AVL Trees, Introduction to M-Way Search Trees, B Trees. Threaded binary trees, Priority Queues –Definition and applications, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, and Deletion from a Max Heap. **Searching:** Sequential Search, Binary Search. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Two Way Merge Sort, and Heap Sort. **Graphs:** Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees – Prim's and Kruskal's Algorithm; Shortest Path Algorithm – Bellman-Ford and Dijkstra's Algorithm. **Hashing & Indexing:** Hash Function, Collision Resolution Strategies. Primary Indices, Secondary Indices, Indexing and Hashing Comparisons.	20

Text Book:

- Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein , "Data Structures Using C and C++", 2nd Edition, PHI, 2009.

Reference Books:

- Horowitz and Sahani , "Fundamentals of Data Structures", 3rd Edition, W H Freeman & Co, 2004-05.
- Jean Paul Trembley and Paul G. Sorenson , "An Introduction to Data Structures with Applications", 2nd Edition, TMH, 2007.
- R. Kruse, "Data Structures and Program Design in C" , 2nd Edition, Pearson Education, 2004.
- Lipschutz Schaum's Outline Series , "Data Structures", 12th Reprint, TMH, 2010.
- G A V Pai , "Data Structures and Algorithms", TMH, 2009.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO7.

Outcome: After completion of course, student will be able to:

- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2
CO3	PO1/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4/PSO3
CO6	PO2/PSO4
CO7	PO2/PSO4

BCSC0007: INTRODUCTION TO MICROPROCESSORS

Objective: *Objective of this subject is to introduce the basic concepts of microprocessor and assembly language programming. Identify and explain the operation of the components of typical microprocessor: the role of the ALU, registers, stack and the use of interrupts.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Microprocessors Evolution and Types, Basics of Pentium Microprocessor, Microprocessor Application, **8-Bit Microprocessor:**8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction Set - Data Transfer Operation, Arithmetic Operation, Logic Operations and Branch Operations; Introduction to Assembly Language Program. **Programming Technique with Additional Instruction**: Looping, Counting, Indexing, Additional Data Transfer and 16-Bit Arithmetic Instruction, Counters and Time Delays, Stack and Subroutine.	20
II	**16 Bit Microprocessor:** Architecture of 8086 – Register Organization, Execution Unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities. **Peripheral Interfacing:** I/O Programming, Programmed I/O, Interrupt Driven I/O, DMA I/O, Memory-Mapped I/Os. **Peripheral Devices:** 8237 DMA Controller, 8255 Programmable Peripheral Interface, 8253/8254 Programmable Timer/Counter, 8259 Programmable Interrupt Controller.	18

Text Books:

- N Senthil Kumar, M Saravanan, and S Jeevananthan , "Microprocessors and Microcontrollers", Oxford University Press India, 2010

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000
- Ray A.K. Bhurchandi.K.M , "Advanced Microprocessor and Peripherals", TMH, 2002.
- D. V. Hall , "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.
- Y.C. Liu and G.A. Gibson , "Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design", 2nd Edition, PHI, 2003

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Demonstrate the Microprocessor internal architecture and its operations.
- CO2: Develop programs based on 8085 microprocessor instruction set and addressing mode.
- CO3: Develop program using looping, counting, indexing, counter and time delays.
- CO4: Understand the concept of stack and subroutine for modular approach.
- CO5: Compare accepted standards and guidelines to select microprocessor (8085 & 8086) to meet performance requirements.
- CO6: Analyze the concept of interfacing the processor to external device with I/O programming & Interrupt Driven I/O.
- CO7: Understand the working of interfacing chips (8237, 8253/54, 8255 & 8259).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1,PSO2
CO3	PO2,PO3/PSO1,PSO2
CO4	PO1,PO2,PO3/PSO1,PSO3
CO5	PO2,PO3,PO5/PSO1,PSO3
CO6	PO1,PO2/PSO3
CO7	PO1,PO2,PO4/PSO3

BCSC 0008: Computer Networks

Objective: *The objective is to understand fundamental underlying principles of computer networking, details and functionality of layered network architecture.*

Credits: 03 **Semester - IV** **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Network Software:** Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Services, Service Primitives, The Relationship of Services to Protocols. Reference Models: The OSI Reference Model, The TCP/IP Reference Model. Example Networks: The Internet, Connection-Oriented Networks (X.25, Frame Relay & ATM), Ethernet. **Introduction Concepts**: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design, Physical Layer Transmission Media, Line coding scheme, switching methods (circuit switching, Packet switching), TDM. **Medium Access sub layer**: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols, CSMA, CSMA/CD, Overview of IEEE standards.	20
II	**Data Link Layer**: Error detection and correction, Flow control (sliding window protocol) **Network Layer**: Network Layer –IP addressing, subnet, CIDR, VLSM, Internetworking, Address mapping, routing. Connecting devices. **Transport Layer**: Transport Layer - Design issues, connection management, Flow control, TCP window management, congestion control-slow start algorithm. **Application Layer**: Data compression, Data Encryption, File Transfer, DNS, HTTP, SMTP, TELNET **Introduction to IPv6, transition from IPv4 to IPv6.**	20

Text Books:

- Forouzan B. A. , "Data Communication and Networking", 4th Edition, McGrawHill, 2004.

References:

- Kurose, J.F. and Ross K.W. , "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Addison-Wesley, 2005.
- A.S. Tanenbaum , "Computer Networks", 2nd Edition, Prentice Hall India, 2006

Focus: This Course focuses on Employability under CO1,CO4,CO4,CO7.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the concept of OSI and TCP/IP reference model.
- CO2: Understand the basics of data transmission at physical layer.
- CO3: Understand the channel allocation using ALOHA, CSMA and CSMA/CD.
- CO4: Apply error detection and correction technique to eliminate transmission error.
- CO5: Analyze the fixed and variable length address (IPv4) subneting for the given scenarios.
- CO6: Understand the design issues of the transport layer.
- CO7: Understand the mechanism of protocols at application layer such as FTP, HTTP, Telnet, DNS.
- CO8: Understand IPv6 addressing and differentiate it from IPv4.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO12/PSO1
CO2	PO1/PSO2
CO3	PO1,PO4/PSO1,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO4,PO6/PSO3
CO6	PO2,PO4/PSO1
CO7	PO5,PO12/PSO2
CO8	PO4,PO7/PSO4

BCSC0009: SOFTWARE ENGINEERING

Objective: *Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility.*

L–T–P-J: 3–0–0-0

Credits: 03

Module No.	Content	Teaching Hours
I	**Introductory Concepts**: The evolving role of software – characteristics, components and applications. **A Generic view of process:** Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. **Process Models:** Waterfall Model, Prototyping, Incremental, Spiral. **Agile software Development**: Introduction to Agile, Agile software development framework. **Software Requirement Specification**: Requirement Process, SRS Components, Requirement Specifications with Use Cases Diagram. **Software Project Planning:** Project Planning Objectives. **Software Metrics:** Size, Function Point, Staffing, Project Estimation Methods–COCOMO Model. **Function-Oriented Design**: Problem Partitioning, Abstraction, Top Down and Bottom Up Design. **Module-Level Concepts:** Coupling, Cohesion, Design Notation and Specification - Structure Charts; Structured Design Methodology - Data Flow Diagram, Sequence Diagram.	20
II	**OO Analysis and OO Design:** OO Concepts, Introduction to UML Design Patterns: Class Diagram, Activity Diagram, State Chart Diagram. **Coding**: Coding Process, Verification – Code Inspections, Software Metrics. **Testing Fundamentals**: Test Case Design, Black Box Testing Strategies, White Box Testing, Unit Testing, Integration Testing, System Testing. **Introduction to Automation Testing and Testing Tools:** Automated Testing Process, Framework for Automation Testing, Introduction to Automation Testing Tool. **Software Quality:** Models, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model. **Software Maintenance**: Models Cost of Maintenance, Re-engineering, Reverse Engineering.	18

Text Books:

- R. S. Pressman , "Software Engineering: A Practitioners Approach", 7thEdition, McGraw Hill, 2010.

Reference Books:

- K. K. Aggarwal and Yogesh Singh ,"Software Engineering", 3rd Edition, New Age International Publishers, 2008.
- Rajib Mall ,, "Fundamentals of Software Engineering", 3rd Edition, PHI Publication, 2009.
- R.E Fairley ,"Software Engineering", McGraw Hill, 2004.
- Sommerville ,"Software Engineering", 9th Edition, Pearson Education, 2010.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of software engineering.

- CO2: Apply software processes to solve real world problems.
- CO3: Estimate the cost, effort and schedule of software using COCOMO Model.
- CO4: Analyze the software design techniques (structure chart, SDM, sequence diagram).
- CO5: Understand the basic concepts of OO analysis and design.
- CO6: Develop the test cases to validate the software.
- CO7: Understand the basic models of software Quality and maintenance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7/PSO1
CO2	PO2,PO3/PSO4
CO3	PO2,PO11/PSO3
CO4	PO3,PO10/PSO4
CO5	PO3,PO7/PSO1
CO6	PO5,PO12/PSO2
CO7	PO4,PO9,PO12/PSO1

BCSC0010: DISCRETE MATHEMATICS

Objective: *The objective is to introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in computer science.*

Credits: 4 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Sets, Relations and Functions:** Introduction to Set Theory, Venn diagrams, algebra of Sets, Inclusion-Exclusion Principle, Partitions, Proof Techniques, Relations, Properties and their types, Function and their types. Recurrence Relations and Generating Functions **Introduction to Counting Principle**: Permutation, Combination, Permutation with Repetition, Combination with Repetition, Pigeonhole Principle. **Probability Theory**: Introduction to Probability Theory, Conditional Probability, Total Probability, Bayes' Theorem.	20
II	**Propositional Logic -** Logical Connectives, Truth Tables, Normal Forms (Conjunctive and Disjunctive), Validity; **Predicate Logic -** Quantifiers, Inference Theory, Methods of Proof: Direct, Indirect, Mathematical Induction. **Algebra**: Motivation of Algebraic Structures, Finite Groups, Subgroups and Group Homomorphism; Lagrange's Theorem; Commutative Rings and Elementary Properties; **Graph Theory:** Introduction to Graphs, Types: Planner, Directed, Complete, Bipartite Graph, Isomorphism , Euler Graph, Hamiltonian Graph, Operations on Graphs, Representation of graphs, Connectivity.	20

Text Book:

- Kenneth H Rosen , "Discrete Mathematics and Its Applications", 7th edition, TMH, 2012.

Reference Books:

- J.P. Tremblay , "Discrete Mathematical Structures with Applications to Computer Science", TMH, New Delhi, 1997.
- V. Krishnamurthy , "Combinatorics: Theory and Applications", East-West Press, New Delhi, 1986.
- Ralph P. Grimaldi , "Discrete and Combinatorial Mathematics- An Applied Introduction", 5th Edition, Pearson Education, 2004.
- C.L. Liu , "Elements of Discrete Mathematics", 2nd Edition, TMH, 2000.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO8.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the notion of mathematical thinking and proofs to solve the problem.
- CO2: Apply the basics of discrete probability and number theory to solve the real world problem.
  CO3: Analyze basic discrete structures and algorithms using effectively algebraic techniques.
- CO4: Analyze mathematical concepts like sets, reasoning, relational algebra and graph theory to solve optimization problems.
- CO5. Analyze the validity of an argument using logical notation.
- CO6. Demonstrate the basic structures of proof techniques to write and evaluate the validity of arguments.
- CO7. Understand the basic principles of sets, set equalities and operations in sets.
- CO8. Apply counting principles to determine probabilities.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO1,PSO3
CO2	PO1,PO3/PSO4
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3
CO5	PO1,PO2/ PSO3
CO6	PO1,PO3/PSO2,PSO3
CO7	PO1,PO2/PSO1
CO8	PO1,PO3/PSO1,PSO4

BCSC0011: THEORY OF AUTOMATA & FORMAL LANGUAGES

Objective: *The objective of this course is that students will study and compare different models and views of the abstract notion of computation and its various aspects.*

Credits:04 **Semester V** **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem; FA with Output - Moore and Mealy machine, Applications and Limitations of FA. **Regular expression (RE):** Regular Expression to FA, DFA to Regular Expression, Arden Theorem, Non Regular Languages, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages. **Push Down Automata (PDA):** Introduction, Language of PDA, Acceptance by Final State, Acceptance by Empty Stack, Deterministic PDA.	20
II	**Context Free Grammar (CFG) and Context Free Languages (CFL):** Introduction, Derivation Trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Simplification of CFGs, Normal Forms for CFGs - CNF and GNF; Pumping lemma for CFLs, Equivalence of PDA and CFG. **Turing machines (TM):** Basic Model, Definition and Representation, Variants of Turing Machine and their equivalence, TM for Computing Integer Functions, Universal TM, Church's Thesis, Recursive and Recursively Enumerable Languages, Halting Problem, Introduction to Computational Complexity. **Decidability:** Post's Correspondence Problem (PCP), Rice's Theorem, Decidability of Membership, Emptiness and Equivalence Problems of Languages.	20

Text Books:

- K.L.P. Mishra and N. Chandrasekaran , "Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI, 2006.

Reference Books:

- Hopcroft, Ullman , "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2013.
- Martin J. C ," Introduction to Languages and Theory of Computations", 4th Edition, TMH, 2011

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO6.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of Context Free languages, Expression and Grammars.
- CO2: Analyze the conversion of NFA to DFA, Mealy to Moore and Moore to Mealy.
- CO3: Analyze the process to convert regular expression to DFA, DFA to regular expression, and minimization of DFA.
- CO4: Develop the PDA for the context free language and context free grammar.
- CO5: Analyze that the grammar is ambiguous or unambiguous.
- CO6: Apply the process to convert CFG to CNF and GNF.
- CO7: Understand the concept of Turing machine and its variants.

- CO8: Design the Turing machine for the real world application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO4
CO2	PO2,PO3/PSO3
CO3	PO2,PO3,PO9,PO12/PSO1,PSO3,PSO4
CO4	PO1,PO3,PO5,PO9/PSO3,PSO4
CO5	PO1,PO2,PO4/PSO3
CO6	PO2,PO3/PSO3
CO7	PO1,PO2/PSO1,PSO3
CO8	PO3,PO12/PSO1,PSO2,PSO3

BCSC0012: DESIGN & ANALYSIS OF ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and concepts including Trees, Recursion & Dynamic programing.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Algorithms, analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Sorting and order Statistics - Shell sort, Quick sort, Merge sort, Heap sort, Comparison of sorting algorithms, Sorting in linear time. **Advanced Data Structures:** Red-Black trees, B – trees, Binomial Heaps, Fibonacci Heaps. Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching.	20
II	Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets Dynamic programming with examples such as Knapsack. All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem	20

Text Books:

- Thomas H. Coremen, Charles E. Leiserson and Ronald L. Rivest, Introduction to Algorithms, Third edition, Prentice Hall of India, 2008

Reference Books:

- Gilles Brassard Paul Bratley ," Fundamentals of Algorithms", Prentice Hall, 1996.
- Ellis Horowitz, SartajSahni, SanguthevarRajasekaran , "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd, 2008.
- Levitin , "An Introduction to Design and Analysis of Algorithms", Pearson., 2008.

Focus: This Course focuses on Employability under CO1,CO2,CO3

Outcome: After completion of course, student will be able to:

- CO1: Understanding of complexity representation in terms of Big Oh, Theta and Omega notations.
- CO2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms (quick sort and merge sort).
- CO3: Compare and analyze different data structures (RB Tree, B Tree, Binomial Heaps, Fibonacci Heaps).
- CO4: Understand the major graph algorithms (DFS, BFS, Dijkstra's Bellman Ford) and their analyses.

- CO5: Understand the greedy paradigm and able to analyze when an algorithmic design situation calls for it. Synthesize greedy algorithms (Optimal Reliability Allocation, Minimum Spanning Trees, factorial Knapsack) and analyze them.
- CO6: Synthesize dynamic-programming algorithms (0/1 knapsack problem, Resource allocation problem, Warshal's and Floyd's algorithms) and analyze them.
- CO7: Understand the backtracking paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize backtracking algorithms (N Queen Problem, TSP Problem, sum of subsets problem, Graph Coloring) and analyze them.
- CO8: Understand the branch and bound paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize branch and bound algorithms (N Queen Problem, TSP Problem, Hamiltonian Cycles, Graph Coloring) and analyze them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4,PO12/PSO1,PSO3
CO2	PO1, PO3,PO4,PO5/PSO1,PSO3
CO3	PO1,PO3, PO6/PSO1,PSO3
CO4	PO1,PO2,PO3, /PSO1,PSO3
CO5	PO1,PO2 /PSO1,PSO3
CO6	PO1,PO2,PO3, PO6/PSO1,PSO3
CO7	PO1,,PO4,PO12/PSO1,PSO3
CO8	PO1,PO2,PO3,PO4,PO12/PSO1,PSO2

BCSC0014: APPLIED DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database& NoSQL system. Students learn how to design and create a good database.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with case studies. **Data Modeling Using the Entity-Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. **Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, Non Redundant Cover, Canonical Cover, MVD and JDs, Inclusion Dependence.	26
II	**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication. **NoSQL System:** RDBMS vs NoSQL, BASE properties, Key-value, Columnar, Document and Graph-Based database, Introduction of MongoDB, Cassandra, Neo4j and Riak. **Database Programming using Python**: Database connectivity, Retrieving Data from Database, Parameters Passing, Executemany Methods, Cursor Attributes, Invoke Stored Procedures, Invoke Stored Functions.	26

Text Books:

- Elmasri and Navathe , “Fundamentals of Database Systems”, 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler , “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. &Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1,CO2,CO9.

Outcome: After completion of course, student will be able to:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss recovery system and be familiar with introduction to web database, distributed databases.
- CO8: Explain the differences between RDBMS and No-SQL,BASE properties and No-SQL databases.
- CO9: Design and implement the database system with the fundamental concepts of DBMS using Python.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2,PO3/PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3/PSO2
CO7	PO1,PO3/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO4
CO9	PO1,PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0808: APPLIED DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL and NoSQL databases.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Introduction to MongoDB and its Installation on Windows or Linux, Description of mongo Shell, create database and show database, Commands for MongoDB and To study operations in MongoDB – Insert, Query, Update, Delete and Projection • To implement Database connectivity using Python	24

References Books:

- Date C J,” An Introduction to Database Systems”, 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , “Database Concepts”, 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, “Database Management System”, TMH
- Sadalage, P. & Fowler , “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.

Focus: This Course focuses on Employability under CO1,CO2,CO3

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Implement the procedural language (PL/SQL) and Triggers.
- CO3: Apply NoSQL queries in MongoDB.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO2,PO3,PO5/PSO2,PSO3
CO3	PO5/PSO2

BCSC0602: INFORMATION SECURITY FUNDAMENTALS

Objective: The objective of this course is to give the basic concepts of Information Security, tools and techniques associated to Information Security.

Credits: 02 **Semester I** **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** CIA Triad, Introduction to Information Security – its elements, PDCA cycle, Types of Security Strategy and its Stakeholders, Threat and Vulnerability, Information Security Issues, Cost Benefit Analysis. **Cryptography and Operations Security:** Introduction to Cryptography: its Types and beenfits, Objective of Cryptographic controls. Types of Cryptographic algorithms, Techniques for cryptography, Attacks on Cryptographic Techniques, Cryptographic Attacks. Cryptography – Cost Categories, **Introduction to Operation Security:** Data Classification, Process of Operation Security and its Benefits. Types of Assets. Threat analysis, Vulnerability analysis. Risk Assessment.	12
II	**Introduction to Physical Security:** Scope and its threats, categories of physical security control. Security in layers, Technical controls. Logging controls, Benefits of Physical security. **Introduction to Network Security:** Its scope. Threat and Vulnerabilities. Secure Network Administration Principles and Tools. Mitigation and Deterrent Techniques. Types of Attacks. **Operating System and Application Security:** Background of Operating Systems, Operating system protection controls. Updating OS for hardening, protecting against Malwares. Vulnerabilities in application. Application Security techniques, Secure software development phases. Introduction to databases – vulnerability and security. Web Application security. **Auditing and Monitoring, Intelligence, Compliance, Management and Governance:** Introduction to Information Security Audit. Auditing standards. Management standards. Data sampling and collection. Monitoring and control. Introduction to Governance, Risk and compliance.	12

Text Books:

Reference Books:

- "Information Security Fundamnetals", by John A. Blackley, Thomas R. Peltier, Justin Peltier(CRC Press)

Focus: This Course focuses on Employability under CO1,CO2,CO4.

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the fundamentals of Information security.
- CO2: Analyze the different Cryptographic Techniques.
- CO3: Understand the need and importance of Physical Security.

- CO4: Explain the scope of Physical and Network security.
- CO5: Understand the need and importance of Operating System hardening.
- CO6: Explain the Auditing & Regulatory standards used in India.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2,PO5/PSO2,PSO3
CO3	PO2,PO5/PSO3,PSO4
CO4	PO2,PO5/PSO3,PSO4
CO5	PO2,PO5/PSO3,PSO4
CO6	PO5/PSO2

BCSC0603: IT Systems Security and Physical Security

Objective: *The objective of this course is to make aware with security issues faced by modern operating systems.*

Credits: 03 **Semester II** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** What is IT System security? Its technical control and risk management, vulnerability mitigation. Operating System security. Security in ordinary operating system – UNIX and Windows. Mobile operating systems. **Endpoint Security:** What is Endpoint Security? Pillars of Endpoint Security. Driver influence endpoint security and its challenges. Gartner's Magic Quadrant. **Application Server Security:** SSL Keys and Certificates, Security Architecture of oracle application server. Introduction to Mobile Application Server security. Introduction to Open Web Application Secuirty Project(OWASP)**Database Server Security:** Architecture of Database systems, its threats and countermeasures. Securing open source databases. **IT System security processes**: Initial Security Control Baseline. Applying operational controls, contingency planning.	20
II	**Introduction to Physical Security:** Importance of Physical security design, physical threats. Relationship between physical and cyber security. Approaches to Physical security: Security plan in levels, tools & techniques. Standards, regulations, guidelines-compliance and your security program, including global resources. **Fire and Safety Inspection:** Its stages, mechanism and classification. Fire safety standard. **Vulnerability Assessment**: Introduction and Basic Terminologies. Vulnerability assessment under Physical security process. System Engineering and Vulnerability Assessment. **Security Surveys and the Audit**: Introduction, Nine points of Security concern. Physical security Audit. Classification of Survey Recommendations. Recommendation Aspects. **Security Lighting, Alarms:** Intrusion Detection Systems. Video technology overview, biometric characteristics, Access controland Badges. **Security Personnel:** Types, Executive protection, Hazard Assessment and Crisis Management.	20

Text Books:

Reference Books:

- IBM-Innovation Centre for Education, "IT Systems Security" Student Guide.
- IBM-Innovation Centre for Education, "Physical Security" Student Guide.

- Lawrence Fenelly, "Effective Physical Security", 3rd Edition.
- Philip Holder and Donna Lea Hawley, "The Executive Protection Professional's Manual".

Focus: This Course focuses on Employability under CO1,CO2,CO3

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the IT System Security scenario.
- CO2: Analyze the challenges in the Server Security.
- CO3: Explain Physical security process.
- CO4: Understand Vulnerability Assessment and Auditing process.
- CO5:Understand the basic concepts of IDS & IPS.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO4,PO5,PO6/PSO1,PSO
CO3	PO3,PO6,PO8/PSO2
CO4	PO1,PO4,PO5/PSO1
CO5	PO1,PO4,PO6/PSO1

BCSG0800: PYTHON PROGRAMMING LAB

Objective: *This course introduces the solving of problems using Python programming using OO concepts and its connectivity with database.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	Programs based on the concepts of: • Building Python Modules • Obtaining user Data • Printing desired output Programs based on the concepts of: • Conditional if statements • Nested if statements • Using else if and elif Programs based on the concepts of Iteration using different kinds of loops Usage of Data Structures • Strings • Lists • Tuples • Sets • Dictionary Program based on the concepts of User-defined modules and Standard Library (random, numpy, scipy, sys, Math Module, String Module, List Module). Program based on Input Output. Program based on exception Handling. Program based on Simple Data analysis. Program based on Pandas.	26

Text Books:

- Paul Barry: “Head First Python “O’Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: “Effective Python: 59 Specific ways to write better Python”, Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3

Outcome: By the end of the course, students will learn to:

- CO1: Apply OO concepts using Python programming.
- CO2: Apply in-built packages defined in Python.

- CO3: Apply front-end as Python Programming to connect with any back-end.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO4
CO3	PO5/PSO2

BCSC0800: COMPUTER PROGRAMMING LAB

Objective: *The objective is to provide a comprehensive study of the C programming language. It stress the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	• Mapping of flow chart, Algorithm, Language • Simple C-program execution • Programs based on various operators • Programs based on Decision and case Control Structure • Programs based on Loop Control Structure • Program based on special control statement ➢ break ➢ continue • Programs based on Array Insertion, Deletion, Linear Search & Bubble Sort • Programs based on String ➢ Length, Copy, Reverse, Concatenate, Compare with & without built-in functions • Programs based on Functions. • Programs based on Storage Class. • Programs based on Recursion. • Programs based on Preprocessor. • Programs based on Pointers • Programs based on array • Programs based on string • Programs based on call by value and call by reference • Programs based on Dynamic Memory Allocation • Programs based on User Defined Data types ➢ Structure and Union ➢ Enum and Typedef • Programs based on File handling ➢ Opening a file ➢ Reading, writing and appending a file ➢ Closing file ➢ Random Access to Files of Records • Programs based on Command Line Argument.	52

Reference Books:

- Herbert Schildt, “C: The Complete Reference”, 5th Edition, McGraw Hill Education
- K. N. King, “C Programming a Modern Approach”, W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, “The C Programming Language”, PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, “Programming in C”, Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1,CO2,CO3

Outcome: On Completion of this course, students are able to:

- CO1: Design programs involving decision structures, loops and functions.
- CO2: Understand the concepts of functions, recursion, pointers and file handling.
- CO3: Design programs involving structures, union and functions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO3/PSO1,PSO2
CO2	PO3,PO4/PSO1
CO3	PO3/PSO2,PSO4

BCSC0801: OBJECT ORIENTED PROGRAMMING LAB

Objective: *The objective of this course is that students will study and learn Object Oriented Modeling and programming.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	Programs in Java and python based on the concepts of: • Classes, Constructors, Polymorphism and Keyword Static. Programs based on the concepts of: • Inheritance, Multithreading Using Thread Class & Interface Runnable, String Handling, Generic Classes. Programs based on the concepts of: • Handling Database Connectivity. • Implementation of Collection Framework. Programs based on the concepts of: • Database Connectivity. • Retrieving Data from Database. • Parameters Passing, Execute many Method. • Cursor Attributes. • Invoke Stored Procedures. • Invoke Stored Functions.	24

Reference Books:

- Naughton, Schildt, "The Complete Reference JAVA2", 9th Edition, Oracle Press.
- Bhave & Patekar, "Programming with Java", Pearson Education
- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Implement object oriented language features.
- CO2: Design GUIs and Graphical programming.
- CO3: Design object oriented solutions for small systems involving database and event handling concepts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO5/PSO2
CO3	PO3,PO5/PSO4

BCSC0802: DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Generation of database report,.	24

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, "Database Management System", TMH

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Develop the SQL queries for real life scenarios.
- CO3: Implement the procedural language (PL/SQL) and Triggers.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO1,PO2/PSO1,PSO4
CO3	PO2,PO3,PO5/PSO2,PSO3

BCSC0803: OPERATING SYSTEMS LAB

Objective: *The lab aims to develop understanding the operation of UNIX operating system.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implement the following basic commands (with options) used in UNIX/LINUX OS. • Write and implement the basic vi editor commands. • Shell scripts that use simple commands. • Decision based Shell scripts. • Shell scripts related to strings. • Shell scripts using pipes. • Shell scripts with loop statements. • Demonstration and solution for race condition. • Demonstration and use of System Calls. • Implement the basics of IPC in UNIX. • Implementation of Classical Problem in Concurrency	24

Reference Books:

- SibsankarHalder and Alex a Aravind ," Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Implement the basic operations on UNIX operating systems.
- CO2: Demonstrate the working of systems calls.
- CO3: Demonstrate message passing in Unix operating system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO4,PO5/PSO1,PSO2

BCSC0804: COMPUTER ORGANIZATION LAB

Objective: *The aim of the lab is to better understand the design of sequential Circuits such as Flip-Flops, Registers, and Counters.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• Bread Board Implementation of Flip-Flops. • Experiments with clocked Flip-Flops. • Design of Counters. • Bread Board implementation of Counters &Shift Registers. • Implementation of Arithmetic Algorithms. • Bread Board implementation of Adder/Subtraction (Half, Full). • Bread Board implementation of Binary Adder. • Bread Board implementation of Seven Segment Display. • Small Project based on combinational and sequential circuit. • Verify the excitation tables of various FLIP-FLOPS . • Design of an 8-bit ARITHMETIC LOGIC UNIT. • Design of 24x8 (16 byte) RAM. • Design of 24x8 (16 byte) STACK. . Implementation of a 4-bit PROCESSOR.	24

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4th **Edition**, Elsevier Publication, 2008.
- William Stalling, "Computer Organization",8th Edition, PHI, 2011.
- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Implement the Combinational and Sequential Circuit.
- CO2: Demonstrate the working of counter and shift register.
- CO3: Demonstrate the working of ALU and seven segment displays.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO5/PSO2
CO2	PO3,PO4/PSO2
CO3	PO3,PO5/PSO1,PSO2

BCSC0805: DATA STRUCTURES & ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module		Lab
I &II	• Program to implement various operations in a singly linked list. • Program to implement insertion, deletion and traversal in a doubly linked List. • Program to implement polynomial addition using linked list. • Program to demonstrate the various operations on stack. • Program to convert an infix expression into postfix expression. • Program to evaluate a given postfix expression. • Program to implement Tower of Hanoi problem using Recursion. • Program to demonstrate the implementation of various operations on linear and circular queue. • Program to demonstrate the implementation of insertion and traversals on a binary search tree. • Program to implement Dijkstra's Algorithm to find the shortest path between source and destination. • Program to search a given element as entered by the user using sequential and binary search to search a given element as entered by the user. • Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort. • To write the following recursive functions for a singly-linked NULL-terminated list: insert(), traverse(), search().	24

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

BCSC0806: MICROPROCESSORS LAB

Objective: *The objective is to introduce the Architecture and programming of the microprocessor and learning about interfacing and various applications of microprocessor.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• To study 8085 microprocessor System. • To study 8086 microprocessor System. • To develop and run basic programs in 8085 ALP. • To develop and run programs in 8085 ALP related to the concept of looping, counting and indexing. • To perform interfacing of RAM chip to 8085/8086. • To perform interfacing of keyboard controller. • To perform interfacing of DMA controller. • To perform interfacing of UART/USART.	24

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- D. V. Hall , "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the arithmetic and logical operations using assembly language programming (8085).
- CO2: Demonstrate the memory operations using assembly language programming (8085).
- CO3: Demonstrate the interfacing of Keyboard, DMA and UART controller.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO2/PSO1,PSO2
CO3	PO1,PO3,PO5/ PSO2

BCSC0807: DESIGN & ANALYSIS OF ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implementation of sorting algorithms: ○ Insertion Sort ○ Bubble Sort ○ Selection Sort ○ Divide and conquer approach: • Quick Sort • Merge Sort ○ Heap Sort ○ Counting Sort • Implementation of Searching Techniques: ○ Linear Search ○ Binary Search • Implementation of Matrix Multiplication • Implementation of Convex Hull • Implementation of Breadth First Search • Implementation of Depth First Search • Implementation of Greedy approaches: ○ Optimal Reliability Allocation. ○ Knapsack. Minimum ○ Minimum Spanning trees: • Prim's and Kruskal's algorithms. ○ Single source shortest paths – • Dijkstra's and Bellman Ford algorithms. • Implementation of Dynamic Programming: ○ Longest Increasing Subsequence. ○ Finding best path in maze. ○ Matrix Chain Multiplication ○ 0/1 Knapsack Problem ○ Resource Allocation Problem	32

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.
- CO2: Demonstrate and use the appropriate data structures for a given problem
- CO3: Implement the algorithms based on Greedy approach and Dynamic Programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO1,PSO2,PSO4
CO2	PO1,PO3,PO4/PSO1,PSO2,PSO3
CO3	PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC 0901 IT SYSTEM SECURITY AND PHYSICAL SECURITY LAB

Objective: The objective of this course is to make aware of the tool Microsoft Baseline Security Analyzer (MBSA) and the tool Tripwire.

Credits: 01 **Semester II** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I&II	**Introduction to Microsoft Baseline Security Analyzer(MBSA)** • Check for missing Windows security updates. • Check for missing IE security updates. • Check for file system type on hard drives • Check if Auto Logon feature is enabled • Check the number of local Administrator accounts. • Check for blank or simple local user account passwords. • Check if unnecessary services are running • Check if automated updates is enabled **Introduction to Tripwire** • Tests for typical and often dangerous Windows configuration errors. • Provides detailed remediation and repair advice. • Test for configuration errors related to OS hardening , data protection, user account activity and audit logging. • Demonstrates how systems can be continually hardened against attack.	24

Text Books:

Reference Books:

- "IT Systems Security", by IBM – ICE(Innovation centre for Education)

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of the course, the student will be able to:

- CO1: Understanding the systems security.
- CO2: Analyzing the system security report.
- CO3: Analyzing on the System Hardening without changing the configuration.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO4,PO5/PSO2
CO3	PO2/PSO3

Program Elective (Only for Specialization Programme)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Cyber Security and Forensics									
THEORY									
1.	BCSE0601	IT Application and Data Security	3	0	0	0	3	3	
2.	BCSE0602	IT Network Security	3	0	0	0	3	3	
3.	BCSE0603	Information Security Audit & Monitoring	2	0	0	0	2	2	
4.	BCSE0604	Cloud Architecture and Deployment Models	3	0	0	0	3	3	
5.	BCSE0605	IT business Continuity & Disaster Recovery	2	0	0	0	2	2	
6.	BCSE0606	Digital Forensics	3	0	0	0	3	3	
7.	BCSE0607	Ethical Hacking and Penetration Testing	2	0	0	0	2	2	
PRACTICALS									
1.	BCSE0631	IT Application and Data Security Lab	0	0	2	0	1	2	
2.	BCSE0632	IT Network Security Lab	0	0	2	0	1	2	
3.	BCSE0633	Information Security Audit & Monitoring Lab	0	0	2	0	1	2	
4.	BCSE0634	Cloud Architecture and Deployment Models Lab	0	0	2	0	1	2	
5.	BCSE0635	Digital Forensics Lab	0	0	2	0	1	2	
6.	BCSE0636	Ethical Hacking and Penetration Testing Lab	0	0	2	0	1	2	
		TOTAL	**18**	**0**	**12**	**0**	**24**	**30**	

BCSE 0601: IT APPLICATION AND DATA SECURITY

Credits: 03 **Semester III** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to software development & application security:** Basics of programming languages, Complied versus interpreted, Programming concepts, Distributed programming, Threats and malware; Importance of software development life cycle: Software development methods; Web application security principles: Application design & development security, Environment and controls, Essence of secure software development **Introduction to input validation & sensitive data:** Implementation of input validation, Practical solutions; Input validation vulnerability: Buffer overflow, Cross site scripting, SQL injection, Canonicalization, Sensitive data, Sensitive data access, Sensitive data in storage, Information disclosure, Data tampering. **Introduction to authentication & authorization:** Network eavesdropping, Brute force attack, Dictionary attack, Cookie replay attack, Credential theft, Elevation of privilege, Basic of authorization, Fata tampering, Luring attack, Phishing attack. **Introduction to configuration management & session management:** Unauthorized access to administration interfaces, Unauthorized access to configuration stores, Retrieval of clear text configuration data, Lack of individual accountability, Over-privileged processs and services accounts; Basics of session management: Hijacking attack, Session replay attack, Man in the middle attack.	13
II	**Introduction to cryptography, parameter manipulation & exception management:** Introduction, Poor key generation or key management, Weak or custom encryption, Basics of parameter manipulation, Cookie manipulation, HTTP Header manipulation, Basics of exception management, Denial of services. **Auditing & logging, Countermeasures:** Introduction to auditing & logging, countermeasures, Basic countermeasures. **Data security threats:** IT Data security – Data security Threats: Need of data security, Importance of data security, Critical data for organization, Elements to consider for a better security mechanisms, Types of data security threats: Malware threat, Network based threats, Cryptographic threats, Database security threats, Types of data security threats: Banking fraud threats, Web-application threats, Physical security threats, Wireless network security threats, Bluetooth devices threats, Data threats in modern era, Benefits of data security. **Data security threat techniques:** Introduction, Threat techniques, Network based threat techniques, Cryptographic threat techniques, Banking fraud techniques, Web-application threat techniques, Wireless network threat techniques. **Countermeasures:** IT data security – countermeasures, The importance of data protection, Evolution of mitigation techniques, Countermeasures, application layer protocols.	14

Text Books:

References:

Focus: This Course focuses on Employability under CO1, CO2, CO3,CO7.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand software development methodology and application security.
- CO2: Explain input validation strategies; protect sensitive data, effective authentication and authorization strategies.
- CO3: Understand various attacks like DoS, buffer overflow, web specific and database specific.
- CO4: Implement security as a culture to show mistakes that make applications vulnerable to attacks.
- CO5: Demonstrate the security enhancements of web based applications.
- CO6: Understand the basics of data security threats.
- CO7: Apply the data security threat techniques and its counter measures.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5/PSO2
CO2	PO1,PO3,PO4/PSO1
CO3	PO1,PO5/PSO2
CO4	PO4,PO5,PO6/PSO4
CO5	PO1,PO5/PSO1
CO6	PO4,PO5,PO6/PSO1
CO7	PO4,PO5,PO7/PSO4

BCSE0631: IT APPLICATION & DATA SECURITY LAB

Objective: This course covers aims to explain various technologies related to IT Application and Data security, practical implementations of various attacks on web based application, and data security.

Credits: 01 **Semester III** **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I & II	• Study of Application Security fundamentals - Ethical Hacking, Social Engineering practices. • Study of Sniffing and Spoofing attacks. • Study of Techniques uses for Web Based Password Capturing. • Study of Symmetric Encryption Scheme – Playfair • Implementation of Asymmetric Encryption Scheme – RSA. • Perform Brute force attack using burpsuite. • Perform phishing attack. • Study of remote security scanning tool Nessus. • Perform SQL Injection. • Study of NMAP scanning tool. • Study of VCG tool.	20

Focus: This Course focuses on Employability under CO1,CO2,CO3

Outcome: After the completion of the course, the student will be able to:

- CO1: Analyze the vulnerabilities and solutions of web based applications.
- CO2: Implement the playfair and RSA Encryption algorithms for data security.
- CO3: Analyze the security of the application using security tools.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO5,PO6/PSO1
CO2	PO1,PO3/PSO2
CO3	PO1,PO4,PO5,PO8/PSO4

BCSE 0602 IT Network Security

Objective: The objective of this course is to make the student understand the various essential security concepts required for achieving Network Security.

Credits: 03 | **Semester IV** | **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Network Fundamentals and its Types. Network Security Threats, Vulnerabilities and Attacks **Network Security Controls, Protocols & Devices:** Access Control Terminology, Types of Authentication, Encryption, Digital Signatures, IDS, VPN, Network Security Protocols, Kerberos, HTTPS, IPSec **Network Security Policy Design and Implementation:** Heirarchy of a Security Policy, Design of a Security Policy, Policy Implementation Checklist, Data Backup Policy **Physical Security:** Physical security controls, checklists. **Host Security:** Host Security Baselining, Auditing Windows registry, Patch Management, Email Security, File System Security, Virtualization Terminologies **Secure IDS Configuration and Management:** Firewalls and concerns, Network Address Translation, Vulnerability based Detection and Blocking IDPS Functions,	20
II	**Secure VPN configuration and Management:** Functions of a VPN Concentrator, VPN core functionality, VPN Topologies, VPN concerns **Wireless Network Defender:** Wireless Terminologies, Wireless Standard, Wireless Network Security. **Network Traffic Monitoring and Analysis:** Advantages of NetworkTraffic Monitoring and Analysis, Network Traffic Signatures, Monitoring and Analyzing FTP, TELNET and HTTP Traffic **Network Risk and Vulnerability Management:** Risk Management Phase, Enterprise Risk Management Framework, Network Vulnerability Assessment Tools **Data Backup and Recovery:** Introduction to Data Backup, STORAGE AREA NETWORK(SAN), Backup Types, Recovery Tools Network Incident Response and Management: Incident Handling and Response, First Responder, Fear Uncertainity and Doubt (FUD), Forensic Investigation	20

Text Books:

- Network Security: The Complete Reference, Roberta Bragg, Mark-Rhodes Ousley, Keith Strassberg. Mc-Grawhill Publication.
- Cyber-Security Essentials, Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short. Sybex Publishers.
- Fundamentals of Cyber Security, Mayank Bhushan, Rajkumar Singh Rathore, Aatif Jamshed. BPB Publications

Reference Books:

- IBM-Innovation Centre for Education, "IT Netwok Security Vol - 1" Student Guide
- IBM-Innovation Centre for Education, "IT Netwok Security Vol - 2" Student Guide

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO7.

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the fundamentals of network security.

- CO2: Demonstrate the principle of network security controls, protocols and devices.
- CO3: Understand the basic concepts of physical and host security, and secure IDS configuration & Management.
- CO4: Explain the network security by using VPN and wireless technologies.
- CO5: Explain the concepts of network traffic monitoring and analysis.
- CO6: Conceptualize the risk management framework and vulnerability management.
- CO7: Explain the concepts of data backup, recovery tools and incident response management.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO4,PO6/PSO2,PSO4
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO6/PSO1,PSO3
CO5	PO2,PO4,PO5/PSO3
CO6	PO1,PO2,PO6/PSO1
CO7	PO1,PO2,PO7/PSO1

BCSE0603: Information Security Audit & Monitoring

Objective: To understand how to assess the department's compliance with the policies defined by the organization, further focusing on IT security aspects and requirements. Also, ensuring that the monitoring applied by means of internal controls over the management of IT security is adequate and effective.

Credits: 02 **Semester - VI** **L–T–P-J: 2–0–1-0**

Module No.	Content	Teaching Hours
I	**Introduction to Information security.** Difference between Cyber Security and Information Security. Inroduction to governance, risk, and compliance standards/framework **Information security for Business**. Business - Information security alignment(BISA) ,Requirement of BISA, Methodology of BISA, Industry best practices in BISA. Information Security as a business enabler, Organizational structure of information security professionals , Roles & responsibilities in the information security functions. Introduction to global standards. Information security framework **CASE STUDY** : Eramba - open Governance, Risk and Compliance (GRC) solution **ISO-27001 standard:** Introduction to ISO27001-2013, ISO27001-2013 Requirements, Implementation lifecycle of ISO 27001 standard, Control objectives and controls, Requirements of ISO standard & statement of applicability, Detailed description of Clause 6 and 8 ,Steps of risk assessment . ISMS framework	10
II	**PCI-DSS standard**: Implementation of PCI-DSS standard ,Requirements of PCI-DSS standard ,Feature of Eramba > controls catalogue Security controls report , Security services ,Support contracts ,Business continuity plan(BCP) ,Security Policies ,Policy Exceptions. **CASE STUDY** : RBI Guidelines for Cyber Security Framework **Security regulatory requirements** : Implementation of security regulatory requirements, Security in BFSI ,Security in telecom sector, Security in Healthcare sector , IT Act of India **Security Assurance & Audits :** Introduction to security assurance and audit, Auditing and security concepts, Audit methodology, Business Skills for Auditors, Creating audit checklists. **CASE STUDY :** Security Auditing Tools (Netwrix Auditor, Nessus, Acunetix, NetworkMiner, etc)	10

Text Books:

- IT - Information Security, Audit and Monitoring - Student Guide V 1.0 (IBM ICE Publication)
- Information Security Fundamentals, 2nd Edition by Thomas R. Peltier
- Information Security: Principles and Practices, Second Edition by Mark S. Merkow, Jim Breithaupt

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO6.

Outcome: After completion of the course, the student will be able to:

- CO1: Explain the governance, risk and compliance standards / framework.
- CO2: Understand Business Information Security Alignment.
- CO3: Explain the ISO/IEC standard.

- CO4: Understand the requirements of PCI-DSS.
- CO5: Understand the importance of Information Security for Indian Government.
- CO6: Understand Auditing and Security Concepts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO5/PSO2
CO2	PO11/PSO4
CO3	PO7/PSO2
CO4	PO1,PO5/PSO2,PSO3
CO5	PO6,PO12/PSO2,PSO4
CO6	PO3,PO5/PSO2

BCSE0633: INFORMATION SECURITY AUDIT & MONITORING LAB

Objective*: This course aims to explain various technologies related to IT Security Audit and Monitoring, practical implementations of various attacks on web based application, system and databases.*

Credits: 01 **Semester V** **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I &II	• Study of various Auditing tools like Edamba, SimpleRisk • Study of Hashing Algorithms like SHA and MD5. • Study of HashCat tool. • Study of Steghide tool. • Nipper tool for both Windows as well as Kali Linux. • Cookies, session monitoring on the websites. • Concept of Same Origin Policy • Revisiting HTML • Perform Cross site Request Forgery • Study of Lynis tool	20

Focus: This Course focuses on Employability under CO1,CO2,CO3

Outcome: After completion of the course, the student will be able to:

- CO1: Analyze and evaluate the cyber security needs of an organization by means of Auditing.
- CO2: Implement different cryptographic methods to have a check on vulnerabilities.
- CO3: Implement session monitoring on the websites.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3,PO5,PO10,PO11/PSO1,PSO2,PSO4
CO2	PO1,PO3,PO5/PSO3,PSO4
CO3	PO3,PO5/PSO2

BCSE0604: CLOUD ARCHITETURE & DEPLOYMENT MODELS

Objective: *The course enables students to understand the virtualization technology, Applications along with cloud computing concepts and services and to study different cloud architecture & deployment models.*

Credits: 03 **Semester - V** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Virtualization:** Overview of Virtualization: Need of Virtualization, shortcoming of physical infrastructure, benefit of Virtualization, comparison of traditional IT infrastructure with virtualized infrastructure. **Virtualization:** Implementing Virtualization, typical hardware / software server stack and its logical equivalence, pre/post virtualization server stack ,types of virtualization, area and technology based classification, history of virtualization, time sharing system, Extending Virtualization to x86 and its hardware support, impact of Virtualization: cost and manageability impact. **Server and Storage Virtualization:** Types of Server Virtualization, simulation, Hardware Assisted Virtualization, Hypervisors, types of Hypervisors, Desktop Virtualization: Benefits Constraints and Types, storage Virtualization overview: benefit and types, features of logical layers, Host level storage Virtualization, host based mirroring, storage level Virtualization, network based storage Virtualization, Network and Application Virtualization. **Introduction to Cloud Computing:** Overview: Introduction to cloud computing, Virtualization and cloud and its overlapping, types of services, business value, business impact of cloud, technological value of cloud, end user benefits, pros and cons of cloud model, anatomy of cloud, benefit of cloud, delivery and deployment model, different cloud architecture: public, private, hybrid and community its pros and cons, Service Models (XaaS), delivery models. Clint-server, cluster, grid models, cloud vs grid and their relationship, cluster and cloud, utility computing and evolution of cloud computing.	20
II	**Cloud computing Architecture:** Conceptual reference model, Cloud Computing solution components. Service Deployment, Cloud service management, IBM CC RA, SLA, Security and privacy **OpenStack:** Definition, Advantages, Releases, Architectural overview, Different components of Open Stack, Open stack- Hypervisors, Network Services, Storage - Block Storage, Object Storage, Choosing Storage Backends, Commodity Storage Backend Technologies: swift, Ceph, Gluster, Multiserver Openstack, Tenant model architecture, **Eucalyptus:** Introduction, Features and Functionality, Architecture, Basic and Advanced Components. Eucalyptus vs Openstack **OpenNebula:** Introduction, Features and Functionality, Architecture, Basic and Advanced Components. OpenNebula vs Openstack	20

Text Books:

- Introduction to Virtualization and Cloud Computing(IBM ICE Publication)
- Cloud Computing Architecture & Deployment Models (IBM ICE Publication)
- Raj Kumar Buyya, James Broberg, Andrezei M.Goscinski , Cloud Computing: Principles and paradigms, 2011.
- Bumgardner, V. C. . OpenStack in action. Manning Publications Company, 2016.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcome: After completion of the course, the student will be able to:

- CO1: Explain the core concepts of the cloud-computing paradigm.
- CO2: Describe the importance of virtualization along with their technologies like system, network, and storage virtualizations.
- CO3: Explain SaaS, PaaS, IaaS, XaaS, Public Cloud, Private Cloud and Hybrid Cloud.
- CO4: Describe the risk and security issues involved with the cloud computing Environment.
- CO5: Analyze the components of OpenStack
- CO6: Understand the Architecture and Components of Cloud Deployment and management tools like Eucalyptus, OpenNebula.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1,PO3,PO5,PO7/PSO2
CO3	PO1,PO5/PSO1
CO4	PO1,PO3,PO5/PSO4
CO5	PO1,PO2/PSO1
CO6	PO1,PO2,PO5/PSO1

BCSE0634: CLOUD ARCHITECTURE AND DEPLOYMENT MODELS LAB

Objective*: This course covers aims to explain various technologies related to Cloud Computing deployment models and their practical implementations, discuss different architectural models of cloud computing, the concepts of virtualization and cloud orchestration.*

Credits: 01 **Semester V** **L–T–P-J: 0–0–2-O**

Module No.	Content	Teaching Hours
I& II	1. a) Introduction to Packet Tracer. b) Network Topologies. (Including explanation of Simple PDU & Complex PDU.) 2. Connecting 3 netwoks using routers. Also, configure DHCP and DNS server. 3. Configuration of different Application services (SMTP, FTP, HTTP, TFTP, DHCP & DNS) 4. Configuration of Vlan and Inter- Vlan Routing. 5. Configure GRE over IP tunnel (VPN). 6. Static NAT configuration. 7. Configure Wireless network. 8. Configure different IoT devices. 9. Study on VMware a. Creating a VM b. Networking on VM c. Merging and splitting disk on VM d. Cloning the guest OS e. Deploying VM with template f. Creating Snapshots g. Managing Users, Groups, Permissions and Roles 10. Creating an EC2 instance on AWS 11. Configuration of db in AWS. 12. Creation of S3 bucket with single IAM user in AWS. 13. Deploying VM on Open Stack platform	18

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of the course, the student will be able to:

- CO1: Implement the networking topologies and routing algorithms on Cisco Packet Tracer.
- CO2: Design Virtual Machines over Type- 1 & Type-2 Hypervisor & Test Client Server application over VMs created.
- CO3: Create the use cases of the key components of Amazon web Service.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs

CO1	PO1,PO3,PO5/PSO1
CO2	PO1,PO3,PO5/PSO2
CO3	PO1,PO3,PO5,PO7/PSO2

BCSE0606:DIGITAL FORENSICS

Objective: *The objective of this course is to emphasize the importance of digital forensics, and to prepare students to conduct a digital investigation in an organized and systematic way. This course will provide theoretical and practical knowledge, as well as current research on Digital Forensics.*

Credits: 03 **Semester - VI** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Computer Forensics:** Standard Procedure, Incident Verification, System identification, Recovery of Erased and damaged data, Disk imaging and preservation, Data encryption and compression, Forensic software. **Network Forensics:** Tracking Network, Reviewing Network Logs, Network Tracking Tools, Live Acquisition of Network Traffic, Order of Volatility, Standard Procedure. **Internet Forensics:** Internet & World wide web threats, Domain Name Ownership Investigation, Reconstructing Past Internet Activities and Events **Email Forensics:** E-mail Analysis, Email Headers and Spoofing **Messenger Forensics:** AOL, Yahoo, MSN, and Chats **Browser Forensics:** Analyzing Cache and Temporary Internet Files, Cookie Storage and Analysis, Web Browsing Activity Reconstruction. **Forensic Investigation and Evidence:** Authorization to collect the evidence, Acquisition of evidence, Authentication of the evidence, Performing RAID Acquisition, Remote Network Data Acquisition Tools, Validating Forensic Data, Analysis of the evidence, Reporting on the findings. **Legal aspects of Digital Forensics:** Definition of Cyber Crime in IT Act, Structure of IT Act, Adjudications and Criminal Provisions, Tampering with computer source documents and Hacking, Online Obscenity & Pornography, Cyber Stalking, Theft of Identity, Cyber Defamation, Admissibility of Digital Evidence.	20
II	**Mobile Forensics:** Collecting and Analyzing Evidence, Analyzing other Storage Devices, Digital Camera Forensics, Recovering and Reconstructing Deleted Data. **Steganalysis - Data Hiding/Recovery:** Introduction to Steganography, Steganography Background, Steganography Functions, Robustness and Cryptography, Steganalysis, Steganography Hierarchy, Image Steganalysis, Digital Image and Audio, Audio Steganalysis, Video Steganalysis, Tools for Steganography, Data Hiding, Data Hiding and Steganography, Alternate Data Stream (ADS). Data Recovery, Reasons Data Recovery, Data recovery chances, Data Recovery Technique, Data Recovery – Scenario, Data Loss prevention, Disk Imaging Technique. **Memory Forensics:** Memory Data Collection and Examination, Data Found in Volatile Memory, Current Analysis Techniques, Current Tools, Cautions and Considerations. **Malware Analysis:** Analyzing Live Windows System for Malware, Analyzing Live Linux System for Malware, Analyzing Physical and Process Memory Dumps for Malware, Discovering and Extracting Malware from Windows Systems, Discovering and Extracting Malware from Linux Systems, Rootkits and Rootkit Detection and Recovery, Reverse Engineering Tools and Techniques.	20

Text Books:

- Digital Forensics, "IBM ICE Publication".
- Digital Forensics: "Digital Evidence in Criminal Investigation", John Wiley & Sons

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcome: After completion of the course, the student will be able to:

- CO1: Understanding computer forensics investigative procedures.
- CO2: Evaluate the systematic collection of evidence at incident scenes.
- CO3: Discuss and analyze computer forensics findings.
- CO4: Understanding of the trade-offs and differences between various forensic tools.
- CO5: Implement and evaluate numbers of methodologies for validating and testing computer forensics tools and evidence.
- CO5: Exhibit forensics ethical behavior and comply with professional conduct requirements

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO3,PO4/PSO2
CO3	PO1,PO3/PSO3
CO4	PO2,PO3,PO5/PSO4
CO5	PO1/PSO1,PSO2

BCSE0635: DIGITAL FORENSICS LAB

Objective: *The objective of this course is to Make student aware of the various tools related to Digital Forensics.*

Credits: 01 **Semester II** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**Perform Digital Forensic Analysis Using Tools for:** • File Encoding and Detection • Timeline Analysis • Encryption and Password Recovery • Steganography Detection • File Extension Renaming and Signature • Email Analysis - Client and Web • Web Analysis • Collection and Analysis of Network Traffic • Wireless Network Traffic • Analysis of Cell phones, PDAs, etc. • Detection of Malicious Code • Reverse Engineering	24

Text Books:

Reference Books:

- "Digital Forensics", by IBM – ICE(Innovation Centre for Education)

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcome: After completion of the course, the student will be able to:

- CO1: Acquire the knowledge on basics of procedures for identification, preservation of electronic evidence
- CO2: Acquire the ability to identify the purpose and usage of various forensic tools
- CO3: Understand how scientific evidence collection/extraction during investigation
- CO4: Appreciate the concepts of file systems and its importance in forensic science.
- CO5: Apply the knowledge of windows and Linux investigation procedures
- CO6: Acquire the knowledge on forensic report writing guidelines and principles

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3
CO2	PO2,PO3,PO4/PSO1
CO3	PO1,PO3/PSO2
CO4	PO2,PO3,PO5/PSO4
CO5	PO1/PSO1,PSO3
CO6	PO2,PO3/PSO3

Objective: The objective of this course is to Understand the value of Business Continuity and Disaster Recovery Model.

Credits: 02 **Semester VI** **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I	**Information Technology Business Continuity & Disaster Recovery Planning:** Importance of Business Continuity Management & Disaster Recovery, Benefits of Business Continuity Management & Disaster Recovery, Know-How of Business Continuity & Disaster Recovery, Business Enablers, Introduction to ISO 22301: BCM Standard. **Introduction to Project Life Cycle:** Fundamentals of Business Continuity Management & Disaster Recovery Planning, project Initiation, Key contributors and Responsibilities, Risk Assessment, Threat and Vulnerability Assessment.	14
II	**Business Impact Analysis and Mitigation Strategy Development:** Basic Understanding of Business Impact Analysis, Identifying and gathering business functions, Determining and preparing the impact report, Introduction to Mitigation Strategy Development, Types and process of Risk Mitigation strategies, IT Risk Mitigation, Backup and Recovery considerations. **Introduction to BCM & DR Plan Development and Management:** Defining BCM & DR teams, assigning resources and defining tasks, Communication Plans, Crisis Management Team.	14

Text Books:

Reference Books:

- IT Business Continuity & Disaster Recovery Planning, Student Guide, Course code CSF07SG01 V1.0, IBM Corporation.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of the course, the student will be able to:

- CO1: Comprehend Information Technology, Business Continuity & Disaster Recovery Planning
- CO2: Appreciate the essence of different phases of Business Continuity & Disaster Recovery planning life cycle.
- CO3 :Realize the probes of Risk Assessment and Mitigation.
- CO4: Interpret the management, auditing and maintenance of Business Continuity & Disaster Recovery planning.
- CO5 : Deploy Catalyst software for Business Continuity & Disaster Recovery planning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3/PSO3
CO2	PO1,PO2,PO4/PSO2
CO3	PO1,PO2/PSO4
CO4	PO1,PO3,PO5/PSO3
CO5	PO1,PO2/PSO1,PSO3

COURSE STRUCTURE

B.TECH.

COMPUTER SCIENCE & ENGINEERING

Specialization

in

Data Analytics

Under

Choice Based Credit System (CBCS)

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Program Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals, researchers or entrepreneurs, for developing sustainable solutions.
PEO2: Attain positions of leadership in an organization and /or on teams.
PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Program Specific Outcome (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.
PSO2: Design and develop hardware and software interfaces along with latest tools and technology to meet the needs of industry.
PSO3: Analyze the algorithmic principles, theory of computation, applied database management systems and mathematical foundations for the modeling and design of computing systems.
PSO4: Apply knowledge to provide innovative solutions to existing problems and identify research gaps.

Program Outcome (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics and science, with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE.

PO2: Problem Analysis: Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of solutions: Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations.

PO4: Conduct Investigations of Complex problems: Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development

PO8: Ethics: Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

PO12: Life-Long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change.

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	CONTACTS HRS/WK
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BPHS0001	Engineering Physics	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication – I	2	0	0	2	2
4.	BEEG0001	Electrical Engineering	3	1	0	4	4
5.	BCSG0001	Python Programming	4	1	0	5	5
6.	BCSC0600	Introduction to Open Source Software & Open Standards	2	0	0	2	2
PRACTICALS							
7.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
8.	BELH0801	English Language Lab – I	0	0	2	1	2
9.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
10.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
11.	BCSG0800	Python Programming Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**26**	**31**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	CONTACTS HRS/WK
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BCSC 1001	C PROGRAMMING	3	1	0	4	4
3.	BELH0002	English Language Skills for Communication – II	2	0	0	2	2
4.	BECG0001	Electronics Engineering	3	1	0	4	4
5.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
6.	BCSC0601	Web Programming through PHP	3	0	0	3	3
PRACTICALS							
7.	BCSC 0800	C PROGRAMMING Lab	0	0	2	1	2
8.	BELH0802	English Language Lab – II	0	0	2	1	2
9.	BECG0800	Electronics Lab I	0	0	2	1	2
10.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1	2
11.	BCSC0800	Web Programming Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**26**	**31**

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
THEORY									
1.	BCSC1001	Computer Programming	3	1	0	0	4	4	
2.	BCSC0002	Object Oriented Programming	3	0	0	0	3	3	Computer Programming
3.	BCSC0003	Database Management System	3	0	0	0	3	3	
4.	BCSC0004	Operating Systems	3	0	0	0	3	3	
5.	BCSC0005	Computer Organization	3	0	0	0	3	3	
6.	BCSC0006	Data Structures & Algorithms	3	1	0	0	4	4	Computer Programming
7.	BCSC0007	Introduction to Microprocessors	3	0	0	0	3	3	Computer Organization
8.	BCSC0008	Computer Networks	3	1	0	0	4	4	
9.	BCSC0009	Software Engineering	3	0	0	0	3	3	
10.	BCSC0010	Discrete Mathematics	3	1	0	0	4	4	
11.	BCSC0011	Theory of Automata & Formal Language	3	1	0	0	4	4	
12.	BCSC0012	Design and Analysis of Algorithm	3	1	0	0	4	4	Data Structures & Algorithms
13.	BCSC0600	Introduction to Open Source Software & Open Standards	2	0	0	0	2	2	
14.	BCSC0601	Web Programming through PHP	3	0	0	0	3	3	Computer Programming
15.	BCSC0014	Applied Database Management System	4	0	0	0	4	4	Database Management System
PRACTICALS									
1.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
2.	BCSC0801	Object Oriented Programming Lab	0	0	2	0	1	2	Programming Lab
3,	BCSC0802	Database Management System Lab	0	0	2	0	1	2	
4.	BCSC0803	Operating Systems Lab	0	0	2	0	1	2	
5.	BCSC0804	Computer Organization Lab	0	0	2	0	1	2	
6.	BCSC0805	Data Structures & Algorithms Lab	0	0	2	0	1	2	Programming Lab
7.	BCSC0806	Microprocessors Lab	0	0	2	0	1	2	Computer Organization Lab
8.	BCSC807	Design and Analysis of Algorithms	0	0	2	0	1	2	
9.	BCSC0601	Web Programming Lab	0	0	2	0	1	2	Programming Lab
10.	BCSC0808	Applied Database Management System	0	0	2	0	1	2	
		Total	**45**	**6**	**20**	**0**	**61**	**71**	

Program Elective (Only for Specialization Programme)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Data Analytics									
THEORY									
1.	BCSE0551	Introduction to Business Analytics	3	0	0	0	3	3	
2.	BCSE0552	Applied Statistical Analysis	3	0	0	0	3	3	Introduction to Business Analytics
3.	BCSE0553	Data Mining and Predictive Modeling	3	0	0	0	3	3	Applied Statistical Analysis
4.	BCSE0554	Data Warehouse & Multidimensional Modeling	3	0	0	0	3	3	Data Mining and Predictive Modeling
5.	BCSE0555	Business Intelligence	3	0	0	0	3	3	
6.	BCSE0556	Hadoop & Big Data Analytics	3	0	0	0	3	3	Data Warehouse & Multidimensional Modeling
7.	BCSE0557	Social, Web & Mobile Analytics	3	0	0	0	3	3	Hadoop & Big Data Analytics
PRACTICALS									
1.	BCSE0581	Applied Statistical Analysis Lab	0	0	2	0	1	2	
2.	BCSE0582	Data Mining and Predictive Modeling Lab	0	0	2	0	1	2	
3.	BCSE0583	Data Warehouse Lab	0	0	2	0	1	2	
4.	BCSE0584	Business Intelligence Lab	0	0	2	0	1	2	
5.	BCSE0585	Hadoop & Big Data Analytics Lab	0	0	2	0	1	2	
6.	BCSE0586	Social, Web & Mobile Analytics Lab	0	0	2	0	1	2	
Total			**21**	**0**	**12**	**0**	**27**	**33**	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BCSJ0950	Mini Project – I	0	0	0	0	2	0	
2.	BCSJ0951	Mini Project – II	0	0	0	0	2	0	
3.	BCSJ0971	Project – Part I	0	0	0	0	3	0	
4.	BCSJ0972	Project – Part II	0	0	0	0	8	0	
5.	BCSJ0991	Industrial Training	0	0	0	0	2	0	
		TOTAL	**0**	**0**	**0**	**0**	**17**	**0**	

Mandatory Non Graded Course

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
		THEORY							
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
5.	BCHM0202	Environmental Studies	2	0	0	0	2	2	
6.	BELM0001	Introduction to Bhagavad Gita	2	0	0	0	2	2	
		TOTAL	**12**	**0**	**0**	**0**	**0**	**12**	

Humanities and Social Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purposes – I	2	0	0	0	2	2	
4.	BELH0004	English for Professional Purposes – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAH0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	8	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	8	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG0001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BCSG0001	Python Programming	4	1	0	0	5	5	
PRACTICALS									
5.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
6.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
7.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
8.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
9.	BCSG0800	Python Programming Lab	0	0	2	0	1	2	

BCSG0001: PYTHON PROGRAMMING

Objective: *This course introduces the solving of mathematical problems using Python programming using OO concepts and its connectivity with database.*

Credits:05 **L-T-P-J:4-1-0-0**

Module No.	Content	Teaching Hours
I	Introduction to Python: Introduction and Basics; Setting up path Python Data Variables & Operators: Data Variables and its types, id () and type () functions, Coding Standards; **Control Structures:** if-else, elif, Nested if, Iteration Control structures, Break, Continue & Pass; **String Manipulation:** Accessing Strings, Basic Operations, String slices Function and Methods. **Lists:** Introduction, accessing list, Operations, Working with lists, Function and Methods. **Tuple:** Introduction, accessing tuples, Operations, Working, Functions and Methods. **Dictionaries:** Introduction, accessing values in dictionaries, Working with dictionaries, Properties , Functions.	22
II	**Functions:** Defining & Calling a function, Passing arguments to functions – Mutable & Immutable Data Types, Different types of arguments, Recursion, Scope of variables; **Modules and Packages:** User-defined modules and Standard Library: random, numpy, scipy, sys, Math Module, String Module, List Module, Date & Time Module, Regular Expressions: match, search, replace; **Input-Output:** Printing on screen, reading data from keyboard, Opening and closing file, Reading and writing files, Functions. **Exception Handling:** Exception, Exception Handling, except clause, try? finally clause, User Defined Exceptions. Basics of Python for Data Analysis, Introduction to series and dataframes& Python using Pandas.	22

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1, CO2,CO3 & CO4.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of Python Programming.
- CO2: Apply the concepts of control structures and string manipulations of python programming.
- CO3: Understand the use of data structures available in Python List, Tuple and Dictionary.
- CO4: Experiment user-defined functions and access built-in functions.
- CO5: Experiment user-defined modules and access built-in modules- math, random, string, date, time, date time.
- CO6: Develop the programs using the concept of File Handling.
- CO7: Develop programs based on Exceptional Handling.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO2/PSO4
CO2	PO4/PSO1
CO3	PO5/PSO4
CO4	PO5,PO7/PSO1
CO5	PO2,PO8/PSO4
CO6	PO3,PO10/PSO2
CO7	PO5,PO9/PSO1

BCSC1001: COMPUTER PROGRAMMING

Objective: *To impart adequate knowledge on the need of problem solving techniques and develop programming skills to implements applications using the concepts of C Language. Also by learning the programming constructs they can easily switch over to any other language in future.*

Credits:05 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Generation of Programming Languages:** Low, Assembly, High and 4GL. **Language Processors:** Compiler, Interpreter, Assembler, Linker and Loader. **Algorithm:** Introduction, Features, Different Ways of stating Algorithms. **Flow Chart:** Introduction, Standard, Guidelines, Advantages and Limitations of using Flowcharts. **Basics of C:** Overview, Structure of a C program, Identifier, Keywords, Variables, Data types, Formatted Input and output. **Operators and Expression:** Assignment, Unary, Arithmetic, Relational, Logical, Bitwise, Conditional, Special operators and their precedence & Associativity. IEEE representation of data types like float & double, Lvalue and Rvalue **Type Conversion:** Type Promotion in expression, Conversion by Assignment, Truncation and Casting Arithmetic expression. **Decision and Case Control Structure:** if, if-else, nested if-else, Decisions using switch, switch versus if-else ladder, goto. **Loop Control Structure:** For loop, while loop, do-while loop, nesting of loops, break, and continue. **Arrays:** Introduction, one-dimensional and two-dimensional Array-Declaration, Initialization, Address Calculation. **Operations on Arrays:** Insertion, Deletion, Linear Search & Bubble Sort. **String:** Introduction, One dimensional and two dimensional Array-Declarations, Initialization **Operations on String:** Length, Copy, Reverse, Concatenate, Compare with & without built-in functions.	25
II	**Functions:** Declaration and Definition, Category of Functions, Parameter Passing Techniques – Call by Value, Passing Arrays to Functions. **Introduction to Storage Classes:** Auto, Static, Extern and Register. **Recursion:** Mechanics of Recursive Call, Implementation of Recursion, Recursion vs. Iteration. **The C Preprocessor:** Introduction, Macro Expansion and File Inclusion, Conditional Compilation and Miscellaneous Directives. **Pointers:** Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Arrays and Pointers, Pointer and Strings, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointer to an Array, Two Dimensional Array and Pointers, Pointers to Functions, Dynamic Memory Allocation, void Pointer and Null Pointer. **User Defined Types:** enum, typedef, Union and Structure - Declaration, Initialization, Nested Structures, Arrays of Structures, Structure and Pointer, Passing Structure Through Function. Difference between Structures and Union. **File Handling:** Data and Information, File Concepts, File Organization, File Operations: Open, Read, and Close, Trouble in Opening a File. File Opening Modes, Working with Text Files. Random Access to Files of Records. Introduction to Command Line Arguments.	25

Text Books:

- Behrouz A. Forouzan and Richard F. Gilberg, "Computer Science – A Structured Programming Approach Using C", C Language Learning, 2007

Reference Books:

- Herbert Schildt, "C: The Complete Reference", 5th Edition, McGraw Hill Education
- K. N. King, "C Programming a Modern Approach", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, "The C Programming Language", PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1, CO2.CO3 & CO4.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of problem solving skills.
- CO2: Apply the basic principles of programming in C language.
- CO3: Understand the concepts of arrays and strings in C language.
- CO4: Apply the concepts of functions to solve real world problems.
- CO5: Illustrate the concepts of recursion.
- CO6: Understand the concepts of pointers in C language.
- CO7: Understand the basic concepts of file handling.
- CO8: Develop algorithmic solutions to simple computational problems.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO10/PSO1,PSO3
CO3	PO1,PO2,PO3,PO4/PSO1,PSO3
CO4	PO1,PO3, PO12/PSO1,PSO2
CO5	PO1,PO2,PO4 /PSO1,PSO3
CO6	PO1,PO2,PO3,PO4/PSO1,PSO2
CO7	PO1,PO3,PO6 /PSO1
CO8	PO1,PO2,PO4,PO10,PO12/PSO1,PSO3

BCSC0002: OBJECT ORIENTED PROGRAMMING

OBJECTIVE: *This course introduces the Object-Oriented programming paradigm to students. It also teaches a student how to think objectively and model a Java program for solving real-world problems.*

CREDITS: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Object-Oriented Programming:** Features of Object-Oriented Programming, Introduction to Object-Oriented Java Programming. **g Java Technology & Environment:** Understanding the compilation process of the JVM, JVM vs JDK vs JRE, Key Features of Java, Structure of a simple Java program. **Working with Java Primitive Data Types:** Strongly Typed nature of Java, Primitive Data Types in Java, The new 'var' keyword, Scope of a variable. **Accepting User Input in Java Programs:** using the Scanner class, using command line arguments. **Programming Constructs:** Sequence, Selection, Iteration & Transfer Statements, For-Each Loop. **Working with Java Arrays**: Declaring and Initializing One-Dimensional and Two-Dimensional Arrays in Java, Introduction to java. util. Arrays class. **The String API:** String Data Type, commonly used methods from the String API, StringTokenizer, StringBuilder & StringBuffer. **Creating and Using Methods:** Signature of a method, Types of Methods, Overloading methods in a class, Static and Non-Static Methods. **Describing and Using Objects & Classes:** Declare the structure of a Java class, declaring members of a class (fields and methods), declaring and using Java Objects, lifecycle of an Object (creation, assignment, dereferencing and garbage collection), Constructors of a class, Overloading Constructors, Constructor chaining using 'this' and 'super' keyword. **Using Java Packages:** create and import Java packages and static imports, abstracting program logic to packages, creating executable main class, running the executable class inside a package. **Applying Encapsulation**: Using access modifiers with/in a class, principles of encapsulation. **Programming Abstractly Through Interfaces:** create and implement Interfaces for programs, private and default methods in Interfaces, declaring Abstract Classes, Constructors in Abstract Classes. Marker Interface, Functional Interfaces, Lambda Expressions in Java.	20
II	**Reusing Implementations using Inheritance:** Declaring Subclasses and Superclasses, extend Abstract Classes, implementing Interfaces, exploring polymorphic behavior by overriding methods, Object Types vs Reference Types, differentiate overloading, overriding and hiding. **Exception Handling:** Exception Hierarchy, Need of Exception Handling, Checked Exceptions, Unchecked Exceptions and Errors, Try-Catch Blocks, Finally, Throw & Throws Keywords, creating and handling Custom Exceptions. **Threads in Java:** Life Cycle of a Thread, creating threads using Runnable and Thread, 'sleep ()', Thread Priorities. **Using Wrapper Classes:** Wrapper Classes in Java, Boxing-Unboxing-Auto Boxing-Auto Unboxing. **Generics & Collections:** Creating Generic classes, Generic Methods, Diamond Notation, Wildcards, Type Erasure, Collection Hierarchy, Base Interfaces, Lists, Sets and Maps.	18

	The Stream API: Introduction to the Stream API, using lambda expressions in Streams. **Regular Expressions:** Pattern and Matcher Class. **JDBC:** JDBC Drivers, Connecting to a MySQL Database, DriverManager, Connection Interface, Statement Interface, Result Set Interface, Prepared Statements.	

Text Book:

- Herbert Schildt , "The Complete Reference, Java Eleventh Edition", Oracle Press, 2019.

Reference Book:

- Cay S Hosrtmann ,"Core Java Volume I—Fundamentals, Eleventh Edition", Pearson, 2018.
- Rogers Cadenhead ,"Sams Teach Yourself Java in 21 Days (Covers Java 11/12), 8th Edition", Pearson, 2020.

Focus: This Course focuses on Employability under CO1, CO2 & CO3.

Outcome: After completion of the course, students will be able to -

- CO1: Understand the basics of Object-Oriented Programming paradigm.
- CO2: Construct the logical flow of programs by using the sequence, selection, iterations and transfer statements.
- CO3: Apply the concepts of Object- Oriented Programming to model programs in Classes, Abstract Classes, Interfaces and Enums, and simplify program function by dissecting it into methods.
- CO4: Understand accessibility of members in a program unit and create packages to prevent namespace collisions.
- CO5: Predict run-time errors in a program by examining program functioning.
- CO6: Show the parallel processing capabilities of a program using a multithreading concept.
- CO7: Experiment with the predefined classes and interfaces defined in the Collections Framework.
- CO8: Develop a program using JDBC connectivity to demonstrate data persistence.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1 /PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/ PSO2
CO7	PO1,PO2,PO11/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO2

BCSC0003: DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database & NoSQL system. Students learn how to design and create a good database.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System Vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with Case Studies. **Data Modeling Using the Entity-Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. **Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization I:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, Non-Redundant Cover, Canonical Cover **PL/SQL:** Query languages, nested queries, group by and having clause.	20
II	**Database Design & Normalization II:** 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, MVD and JDs, Inclusion Dependence. **File Organization:** Indexing, Structure of Index files and Types, Dense and Sparse Indexing **Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication.	20

Text Books:

- Elmasri and Navathe, “Fundamentals of Database Systems”, 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler , “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.

References Books:

- Date C J,” An Introduction to Database Systems”, 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan, “Database Concepts”, 5th Edition, TMH, 1998.
- Redmond, E. & Wilson, “Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement”, 1st Edition.

Focus: This Course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After the completion of the course, the student will:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.

- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss indexing mechanisms for efficient retrieval of information from a database.
- CO8: Discuss recovery system and be familiar with introduction to web database, distributed databases.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1 /PSO1
CO2	PO2, PO3/ PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3,PO9/ PSO2
CO7	PO1,PO11 /PSO1
CO8	PO1,PO3,PO12/ PSO2

BCSC0004: OPERATING SYSTEMS

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Operating System and its Classification - Batch, Interactive, Multiprogramming, Time sharing, Real Time System, Multiprocessor Systems, Multithreaded Systems, System Protection, System Calls, Reentrant Kernels, Operating System Structure- Layered structure, Monolithic and Microkernel Systems, Operating System Components, Operating System Functions and Services. **Processes:** Process Concept, Process States, Process State Transition Diagram, Process Control Block (PCB), Process Scheduling Concepts, Threads and their management. **Process Synchronization:** Principle of Concurrency, Implementation of concurrency through fork/join and parbegin/parend, Inter Process Communication models, shared memory and message passing Schemes, Producer / Consumer Problem, Critical Section Problem, race condition ,two process software solution Dekker's solution, Peterson's solution, Semaphores, Synchronization Hardware. **Classical Problem in Concurrency:** Dining Philosopher Problem, Readers Writers Problem, sleeping barbar,	20
II	**Deadlock:** System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock, Combined Approach. **Memory Management:** Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation. **Virtual memory concepts:** Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Locality of reference. **I/O Management and Disk Scheduling:** I/O devices, I/O subsystems, I/O buffering, Disk storage and disk scheduling. **File System:** File concept, File organization and access mechanism, File directories, File allocation methods, Free space management.	20

Text Books:

- Silberschatz, Galvin and Gagne, "Operating Systems Concepts",9th Edition, Wiley, 2012.

Reference Books:

- Sibsankar Halder and Alex a Aravind, " Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4 & CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the classification of operating system environment.
- CO2: Understand the basic of process management.
- CO3: Apply the concept of CPU process scheduling for the given scenarios.
- CO4: Illustrate the process synchronization and concurrency process in operating system.
- CO5: Analyze the occurrence of deadlock in operating system.
- CO6: Describe and analyze the memory management and its allocation policies.
- CO7: Understand the concepts of disk scheduling.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO4/PSO1,POS3
CO4	PO3,PO4,PO6/PSO3,PSO4
CO5	PO1,PO4/PSO1,PSO3
CO6	PO1,PO2 /PSO1,PSO3
CO7	PO1,PO2,PO7/PSO1,PSO3

BCSC0005: COMPUTER ORGANIZATION

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**PREAMBLE:** Subject Introduction, Basic organization of the computer and block level description of the functional units, Number Representation, Fixed and floating-point Number Representation-Arithmetic Addition/subtraction, overflow, IEEE standard for floating point representation, **Basic Computer Organization and Design:** Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description. Introduction to combinational circuit - Half Adder, Full Adder, carry look ahead adder, Multiplexor/ De multiplexer and Decoder/Encoder, Introduction to sequential circuit- Flip-Flops, Synchronous and Asynchronous Counters, Register, Bus and memory Transfer Language. **Arithmetic Operations:** Addition and subtraction of signed numbers, Hardware implementation of Method, Multiplication: Signed operand multiplication, Booths algorithm, Hardware implementation of Algorithms, Array Multiplier. **Processor Organization:** General register organization, Single Accumulator and Stack organization, Addressing Modes, Types of Computer Instructions – one, two, three & four address, Instruction Cycle, Instruction Formats.	20
II	**Micro-operations:** Arithmetic, Logical & Shift Micro operations with some applications. **Multiprogramming and Multiprocessing:** Introduction to pipelined operation. **Hardwired & Microprogrammed Unit:** Execution of a complete instruction & Branch Instructions, Hardwired control Unit, Micro programmed control Unit, Micro-Instructions, Microinstruction with Next Address field, Pre-Fetching Microinstructions, Concept of Horizontal and Vertical Microprogramming. **Memory:** Basic concept and Hierarchy, RAM memories, 2D, 2 & 1/2D Memory Organization, ROM Memories, Cache Memories: Concept and Design issues performance, Address mapping and Replacement, Auxiliary memories: Magnetic disk, Magnetic tape and Optical disks, Virtual memory: Concept and Implementation. Input/Output: Peripheral Devices, I/O interface, I/O ports. **Interrupts:** Interrupt hardware, Types of Interrupts and Exceptions, Buses, Bus architecture, Types of Buses and Bus Arbitration. Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O, Direct Memory Access, I/O channels and Processors, Standard communication interfaces.	**20**

Text Books:

- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Reference Books:

- D.W. Patterson ,"Computer Organization and Design", 4th**Edition**, Elsevier Publication, 2008.
- William Stalling ,"Computer Organization",8th Edition, PHI, 2011.
- V. CarlHamacher, Zaky ,"Computer Organization",4th International Edition, TMH, 1996.

- John P Hays, "Computer Organization", 2nd Edition, TMH.
- Tannenbaum ,"Structured Computer Organization", 5thEdition, PHI, 2005.
- P Pal Chaudhry ,"Computer Organization & Design", 2ndEdition, PHI, 2002.

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4 & CO5.

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the basics of digital computer system.
- CO2: Demonstrate the principle of arithmetic operations on unsigned, signed integers and floating point numbers.
- CO3: Understand the concepts of Combinational and Sequential circuits and their applications.
- CO4: Understand the CPU architecture and organization.
- CO5: Explain the basic concepts of pipelining.
- CO6: Design the steps for the execution of the complete instruction for hardwired and micro-programmed control unit.
- CO7: Explain the function of memory hierarchy.
- CO8: Determine the interface of CPU with input/output devices and their modes of transfer.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO1,PO3/PSO1
CO3	PO2,PO3,PO5/PSO2
CO4	PO2,PO3,PO4/PSO1,PSO3
CO5	PO2,PO3,PO4/PSO2
CO6	PO1,PO2,PO3/PSO1,PSO3
CO7	PO2,PO3,PO5/PSO2,PSO3
CO8	PO3,PO4/PSO1

BCSC0006: DATA STRUCTURES AND ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs*.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Terminology, Elementary Data Organization, Properties of an Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic Notations – Big-Oh; Operations on Data Structure, Abstract Data Types (ADT). **Linked Lists:** Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Generalized Linked List, Polynomial Representation and Addition. **Stacks:** Primitive Stack Operations **-** Push & Pop, Array and Linked Implementation of Stack in C, Application of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of Infix to Postfix expression, Recursion, Principles of Recursion, Tail Recursion, Removal of Recursion, use of stack in Recursion, Tower of Hanoi Problem. **Queues:** Operations on Queue **-** Add, Delete operations, Implementation of Queue Using Array and Linked List, Circular Queues, Deque and Priority Queue. **Trees:** Basic Terminology, Array Representation and Dynamic Representation; Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Tree Traversal Algorithms - Inorder, Preorder and Postorder; Threaded Binary Trees, Traversing Threaded Binary Trees.	20
II	**Search Trees:** Binary Search Trees (BST), Insertion and Deletion in BST, AVL Trees, Introduction to M-Way Search Trees, B Trees. Threaded binary trees, Priority Queues –Definition and applications, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, and Deletion from a Max Heap. **Searching:** Sequential Search, Binary Search. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Two Way Merge Sort, and Heap Sort. **Graphs:** Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees – Prim's and Kruskal's Algorithm; Shortest Path Algorithm – Bellman-Ford and Dijkstra's Algorithm. **Hashing & Indexing:** Hash Function, Collision Resolution Strategies. Primary Indices, Secondary Indices, Indexing and Hashing Comparisons.	20

Text Book:

- Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein , "Data Structures Using C and C++", 2nd Edition, PHI, 2009.

Reference Books:

- Horowitz and Sahani ,"Fundamentals of Data Structures", 3rd Edition, W H Freeman & Co, 2004-05
- Jean Paul Trembley and Paul G. Sorenson ,"An Introduction to Data Structures with Applications", 2nd Edition, TMH, 2007.
- R. Kruse, "Data Structures and Program Design in C" ,2nd Edition, Pearson Education, 2004.
- Lipschutz Schaum's Outline Series ,"Data Structures", 12th Reprint, TMH, 2010.
- G A V Pai , "Data Structures and Algorithms", TMH, 2009.

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4, CO5 & CO6.

Outcome: After completion of course, student will be able to:

- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.

- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2
CO3	PO1/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4/PSO3
CO6	PO2/PSO4
CO7	PO2/PSO4

BCSC0007: INTRODUCTION TO MICROPROCESSORS

Objective: *Objective of this subject is to introduce the basic concepts of microprocessor and assembly language programming. Identify and explain the operation of the components of typical microprocessor: the role of the ALU, registers, stack and the use of interrupts.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Microprocessors Evolution and Types, Basics of Pentium Microprocessor, Microprocessor Application, **8-Bit Microprocessor:**8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction Set - Data Transfer Operation, Arithmetic Operation, Logic Operations and Branch Operations; Introduction to Assembly Language Program. **Programming Technique with Additional Instruction**: Looping, Counting, Indexing, Additional Data Transfer and 16-Bit Arithmetic Instruction, Counters and Time Delays, Stack and Subroutine.	20
II	**16 Bit Microprocessor:** Architecture of 8086 – Register Organization, Execution Unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities. **Peripheral Interfacing:** I/O Programming, Programmed I/O, Interrupt Driven I/O, DMA I/O, Memory-Mapped I/Os. **Peripheral Devices:** 8237 DMA Controller, 8255 Programmable Peripheral Interface, 8253/8254 Programmable Timer/Counter, 8259 Programmable Interrupt Controller.	18

Text Books:

- N Senthil Kumar, M Saravanan, and S Jeevananthan , "Microprocessors and Microcontrollers", Oxford University Press India, 2010.

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- Ray A.K. Bhurchandi.K.M ,"Advanced Microprocessor and Peripherals", TMH, 2002.
- D. V. Hall ,"Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.
- Y.C. Liu and G.A. Gibson ,"Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design", 2nd Edition, PHI, 2003.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After the completion of the course, the student will be able to:

- CO1: Demonstrate the Microprocessor internal architecture and its operations.
- CO2: Develop programs based on 8085 microprocessor instruction set and addressing mode.
- CO3: Develop program using looping, counting, indexing, counter and time delays.
- CO4: Understand the concept of stack and subroutine for modular approach.
- CO5: Compare accepted standards and guidelines to select microprocessor (8085 & 8086) to meet performance requirements.
- CO6: Analyze the concept of interfacing the processor to external device with I/O programming & Interrupt Driven I/O.
- CO7: Understand the working of interfacing chips (8237, 8253/54, 8255 & 8259).

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1,PSO2
CO3	PO2,PO3/PSO1,PSO2
CO4	PO1,PO2,PO3/PSO1,PSO3
CO5	PO2,PO3,PO5/PSO1,PSO3
CO6	PO1,PO2/PSO3
CO7	PO1,PO2,PO4/PSO3

BCSC 0008: Computer Networks

Objective: *The objective is to understand fundamental underlying principles of computer networking, details and functionality of layered network architecture.*

Credits: 03 **Semester - IV** **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Network Software:** Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Services, Service Primitives, The Relationship of Services to Protocols. Reference Models: The OSI Reference Model, The TCP/IP Reference Model. Example Networks: The Internet, Connection-Oriented Networks (X.25, Frame Relay & ATM), Ethernet. **Introduction Concepts**: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design, Physical Layer Transmission Media, Line coding scheme, switching methods (circuit switching, Packet switching), TDM. **Medium Access sub layer**: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols, CSMA, CSMA/CD, Overview of IEEE standards.	20
II	**Data Link Layer**: Error detection and correction, Flow control (sliding window protocol) **Network Layer**: Network Layer –IP addressing, subnet, CIDR, VLSM, Internetworking, Address mapping, routing. Connecting devices. **Transport Layer**: Transport Layer - Design issues, connection management, Flow control, TCP window management, congestion control-slow start algorithm. **Application Layer**: Data compression, Data Encryption, File Transfer, DNS, HTTP, SMTP, TELNET **Introduction to IPv6, transition from IPv4 to IPv6.**	20

Text Books:

- Forouzan B. A. , "Data Communication and Networking", 4th Edition, McGrawHill, 2004.

References:

- Kurose, J.F. and Ross K.W. ,"Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Addison-Wesley, 2005.
- A.S. Tanenbaum , "Computer Networks", 2nd Edition, Prentice Hall India, 2006.

Focus: This Course focuses on Employability under CO1, CO2,CO3,CO4,CO5.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the concept of OSI and TCP/IP reference model.
- CO2: Understand the basics of data transmission at physical layer.
- CO3: Understand the channel allocation using ALOHA, CSMA and CSMA/CD.
- CO4: Apply error detection and correction technique to eliminate transmission error.
- CO5: Analyze the fixed and variable length address (IPv4) subneting for the given scenarios.
- CO6: Understand the design issues of the transport layer.
- CO7: Understand the mechanism of protocols at application layer such as FTP, HTTP, Telnet, DNS.
- CO8: Understand IPv6 addressing and differentiate it from IPv4.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO12/PSO1
CO2	PO1/PSO2

CO3	PO1,PO4/PSO1,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO4,PO6/PSO3
CO6	PO2,PO4/PSO1
CO7	PO5,PO12/PSO2
CO8	PO4,PO7/PSO4

BCSC0009: SOFTWARE ENGINEERING

Objective: *Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introductory Concepts**: The evolving role of software – characteristics, components and applications. **A Generic view of process:** Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. **Process Models:** Waterfall Model, Prototyping, Incremental, Spiral. **Agile software Development**: Introduction to Agile, Agile software development framework. **Software Requirement Specification**: Requirement Process, SRS Components, Requirement Specifications with Use Cases Diagram. **Software Project Planning:** Project Planning Objectives. **Software Metrics:** Size, Function Point, Staffing, Project Estimation Methods–COCOMO Model. **Function-Oriented Design**: Problem Partitioning, Abstraction, Top Down and Bottom Up Design. **Module-Level Concepts:** Coupling, Cohesion, Design Notation and Specification - Structure Charts; Structured Design Methodology - Data Flow Diagram, Sequence Diagram.	20
II	**OO Analysis and OO Design:** OO Concepts, Introduction to UML Design Patterns: Class Diagram, Activity Diagram, State Chart Diagram. **Coding**: Coding Process, Verification – Code Inspections, Software Metrics. **Testing Fundamentals**: Test Case Design, Black Box Testing Strategies, White Box Testing, Unit Testing, Integration Testing, System Testing. **Introduction to Automation Testing and Testing Tools:** Automated Testing Process, Framework for Automation Testing, Introduction to Automation Testing Tool. **Software Quality:** Models, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model. **Software Maintenance**: Models Cost of Maintenance, Re-engineering, Reverse Engineering.	18

Text Books:

- R. S. Pressman , “Software Engineering: A Practitioners Approach”, 7thEdition, McGraw Hill, 2010.

Reference Books:

- K. K. Aggarwal and Yogesh Singh ,“Software Engineering”, 3rd Edition, New Age International Publishers, 2008.
- Rajib Mall ,“Fundamentals of Software Engineering”, 3rd Edition, PHI Publication, 2009.
- R.E Fairley ,“Software Engineering”, McGraw Hill, 2004.
- Sommerville ,“Software Engineering”, 9th Edition, Pearson Education, 2010.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of software engineering.
- CO2: Apply software processes to solve real world problems.
- CO3: Estimate the cost, effort and schedule of software using COCOMO Model.
- CO4: Analyze the software design techniques (structure chart, SDM, sequence diagram).
- CO5: Understand the basic concepts of OO analysis and design.
- CO6: Develop the test cases to validate the software.
- CO7: Understand the basic models of software Quality and maintenance.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO7/PSO1
CO2	PO2,PO3/PSO4
CO3	PO2,PO11/PSO3
CO4	PO3,PO10/PSO4
CO5	PO3,PO7/PSO1
CO6	PO5,PO12/PSO2
CO7	PO4,PO9,PO12/PSO1

BCSC0010: DISCRETE MATHEMATICS

Objective: *The objective is to introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in computer science.*

Credits: 4 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Sets, Relations and Functions:** Introduction to Set Theory, Venn diagrams, algebra of Sets, Inclusion-Exclusion Principle, Partitions, Proof Techniques, Relations, Properties and their types, Function and their types. Recurrence Relations and Generating Functions **Introduction to Counting Principle**: Permutation, Combination, Permutation with Repetition, Combination with Repetition, Pigeonhole Principle. **Probability Theory**: Introduction to Probability Theory, Conditional Probability, Total Probability, Bayes' Theorem.	20
I I	**Propositional Logic -** Logical Connectives, Truth Tables, Normal Forms (Conjunctive and Disjunctive), Validity; **Predicate Logic -** Quantifiers, Inference Theory, Methods of Proof: Direct, Indirect, Mathematical Induction. **Algebra**: Motivation of Algebraic Structures, Finite Groups, Subgroups and Group Homomorphism; Lagrange's Theorem; Commutative Rings and Elementary Properties; **Graph Theory:** Introduction to Graphs, Types: Planner, Directed, Complete, Bipartite Graph, Isomorphism , Euler Graph, Hamiltonian Graph, Operations on Graphs, Representation of graphs, Connectivity.	20

Text Book:

- Kenneth H Rosen , "Discrete Mathematics and Its Applications", 7th edition, TMH, 2012.

Reference Books:

- J.P. Tremblay, "Discrete Mathematical Structures with Applications to Computer Science", TMH, New Delhi, 1997.
- V. Krishnamurthy, "Combinatorics: Theory and Applications", East-West Press, New Delhi, 1986.
- Ralph P. Grimaldi ," Discrete and Combinatorial Mathematics- An Applied Introduction", 5th Edition, Pearson Education, 2004
- C.L. Liu ,"Elements of Discrete Mathematics", 2nd Edition, TMH, 2000.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the notion of mathematical thinking and proofs to solve the problem.
- CO2: Apply the basics of discrete probability and number theory to solve the real world problem. CO3: Analyze basic discrete structures and algorithms using effectively algebraic techniques.
- CO4: Analyze mathematical concepts like sets, reasoning, relational algebra and graph theory to solve optimization problems.
- CO5. Analyze the validity of an argument using logical notation.
- CO6. Demonstrate the basic structures of proof techniques to write and evaluate the validity of arguments.
- CO7. Understand the basic principles of sets, set equalities and operations in sets.
- CO8. Apply counting principles to determine probabilities.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO3
CO2	PO1,PO3/PSO4
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3
CO5	PO1,PO2/ PSO3
CO6	PO1,PO3/PSO2,PSO3
CO7	PO1,PO2/PSO1
CO8	PO1,PO3/PSO1,PSO4

BCSC0011: THEORY OF AUTOMATA & FORMAL LANGUAGES

Objective: *The objective of this course is that students will study and compare different models and views of the abstract notion of computation and its various aspects.*

Credits:04 **Semester V** **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem; FA with Output - Moore and Mealy machine, Applications and Limitations of FA. **Regular expression (RE):** Regular Expression to FA, DFA to Regular Expression, Arden Theorem, Non Regular Languages, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages. **Push Down Automata (PDA):** Introduction, Language of PDA, Acceptance by Final State, Acceptance by Empty Stack, Deterministic PDA.	20
II	**Context Free Grammar (CFG) and Context Free Languages (CFL):** Introduction, Derivation Trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Simplification of CFGs, Normal Forms for CFGs - CNF and GNF; Pumping lemma for CFLs, Equivalence of PDA and CFG. **Turing machines (TM):** Basic Model, Definition and Representation, Variants of Turing Machine and their equivalence, TM for Computing Integer Functions, Universal TM, Church's Thesis, Recursive and Recursively Enumerable Languages, Halting Problem, Introduction to Computational Complexity. **Decidability:** Post's Correspondence Problem (PCP), Rice's Theorem, Decidability of Membership, Emptiness and Equivalence Problems of Languages.	20

Text Books:

- K.L.P. Mishra and N. Chandrasekaran ,"Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI, 2006.

Reference Books:

- Hopcroft, Ullman ,"Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2013.
- Martin J. C , " Introduction to Languages and Theory of Computations", 4th Edition, TMH, 2011.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of Context Free languages, Expression and Grammars.
- CO2: Analyze the conversion of NFA to DFA, Mealy to Moore and Moore to Mealy.
- CO3: Analyze the process to convert regular expression to DFA, DFA to regular expression, and minimization of DFA.
- CO4: Develop the PDA for the context free language and context free grammar.
- CO5: Analyze that the grammar is ambiguous or unambiguous.
- CO6: Apply the process to convert CFG to CNF and GNF.
- CO7: Understand the concept of Turing machine and its variants.
- CO8: Design the Turing machine for the real world application.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO4
CO2	PO2,PO3/PSO3
CO3	PO2,PO3,PO9,PO12/PSO1,PSO3,PSO4
CO4	PO1,PO3,PO5,PO9/PSO3,PSO4
CO5	PO1,PO2,PO4/PSO3
CO6	PO2,PO3/PSO3
CO7	PO1,PO2/PSO1,PSO3
CO8	PO3,PO12/PSO1,PSO2,PSO3

BCSC0012: DESIGN & ANALYSIS OF ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and concepts including Trees, Recursion & Dynamic programming.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Algorithms, analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Sorting and order Statistics - Shell sort, Quick sort, Merge sort, Heap sort, Comparison of sorting algorithms, Sorting in linear time. **Advanced Data Structures:** Red-Black trees, B – trees, Binomial Heaps, Fibonacci Heaps. Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching.	20
II	Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets Dynamic programming with examples such as Knapsack. All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem	20

Text Books:

- Thomas H. Coremen, Charles E. Leiserson and Ronald L. Rivest , Introduction to Algorithms, Third edition, Prentice Hall of India, 2008.

Reference Books:

- Gilles Brassard Paul Bratley , " Fundamentals of Algorithms", Prentice Hall, 1996.
- Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran , "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd, 2008.
- Levitin , "An Introduction to Design and Analysis of Algorithms", Pearson, 2008.

Focus: This Course focuses on Employability under CO1, CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Understanding of complexity representation in terms of Big Oh, Theta and Omega notations.
- CO2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms (quick sort and merge sort).
- CO3: Compare and analyze different data structures (RB Tree, B Tree, Binomial Heaps, Fibonacci Heaps).
- CO4: Understand the major graph algorithms (DFS, BFS, Dijkstra's Bellman Ford) and their analyses.
- CO5: Understand the greedy paradigm and able to analyze when an algorithmic design situation calls for it. Synthesize greedy algorithms (Optimal Reliability Allocation, Minimum Spanning Trees, factorial Knapsack) and analyze them.

- CO6: Synthesize dynamic-programming algorithms (0/1 knapsack problem, Resource allocation problem, Warshal's and Floyd's algorithms) and analyze them.
- CO7: Understand the backtracking paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize backtracking algorithms (N Queen Problem, TSP Problem, sum of subsets problem, Graph Coloring) and analyze them.
- CO8: Understand the branch and bound paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize branch and bound algorithms (N Queen Problem, TSP Problem, Hamiltonian Cycles, Graph Coloring) and analyze them.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4,PO12/PSO1,PSO3
CO2	PO1, PO3,PO4,PO5/PSO1,PSO3
CO3	PO1,PO3, PO6/PSO1,PSO3
CO4	PO1,PO2,PO3, /PSO1,PSO3
CO5	PO1,PO2 /PSO1,PSO3
CO6	PO1,PO2,PO3, PO6/PSO1,PSO3
CO7	PO1,,PO4,PO12/PSO1,PSO3
CO8	PO1,PO2,PO3,PO4,PO12/PSO1,PSO2

BCSC0014: APPLIED DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database& NoSQL system. Students learn how to design and create a good database.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with case studies. **Data Modeling Using the Entity-Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. **Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, Non Redundant Cover, Canonical Cover, MVD and JDs, Inclusion Dependence.	26
II	**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication. **NoSQL System:** RDBMS vs NoSQL, BASE properties, Key-value, Columnar, Document and Graph-Based database, Introduction of MongoDB, Cassandra, Neo4j and Riak. **Database Programming using Python**: Database connectivity, Retrieving Data from Database, Parameters Passing, Executemany Methods, Cursor Attributes, Invoke Stored Procedures, Invoke Stored Functions.	26

Text Books:

- Elmasri and Navathe , "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. &Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss recovery system and be familiar with introduction to web database, distributed databases.
- CO8: Explain the differences between RDBMS and No-SQL,BASE properties and No-SQL databases.
- CO9: Design and implement the database system with the fundamental concepts of DBMS using Python.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2,PO3/PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3/PSO2
CO7	PO1,PO3/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO4
CO9	PO1,PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0808: APPLIED DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL and NoSQL databases.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Introduction to MongoDB and its Installation on Windows or Linux, Description of mongo Shell, create database and show database, Commands for MongoDB and To study operations in MongoDB – Insert, Query, Update, Delete and Projection • To implement Database connectivity using Python	24

References Books:

- Date C J,” An Introduction to Database Systems”, 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan ,“Database Concepts”, 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, “Database Management System”, TMH
- Sadalage, P. & Fowler ,“NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4 & CO5.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Implement the procedural language (PL/SQL) and Triggers.
- CO3: Apply NoSQL queries in MongoDB.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO2,PO3,PO5/PSO2,PSO3
CO3	PO5/PSO2

BCSC0600: INTRODUCTION TO OPEN SOURCE SOFTWARE AND OPEN STANDARDS

Objective: *The objective of this is to give the concept of Open Source Software and to learn the Open Source Adoption History and Evolution.*

Credits: 02 **Semester - I** **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Open Source:** Introduction to Open Source Software - History of Open Source Software, Initiation of Open Source project start; Open Source Software examples: The Origins, The GNU projects, The Operating System GNU/Linux, The Graphical User Interface KDE/GNOME, Apache Web Server, **Application Software**; Strengths and Advantages of Open Source Software - Network effects, Lower cost, Availability, Maintainability. Drivers for Adoption - Lower cost of ownership, Quality, Innovation reuse, Technical competence; Open Source Software Assessment, Examples of Open Source Adoption in the World, Open Source Challenges. Standards , Licenses ,Contribution to open source community-Evolution of UNIX, GNU General Public License - Genesis of GNU Myth Buster, Brook's law; Open Source Community; Apache Web Server; Apache Software Foundation (ASF); How to contribute to open source projects.	13
II	**Introduction to standards**, Types of standard, Lifecycle of standard, Importance and benefits of standards. **Adoption of Open Source**: Introduction; Drivers for Open Source adoption; Adoption Methods and Process; examples of Open Standard Adoptions in the World; Open Source Challenges .**Case Study On Open Standard and Software:** Introduction. Case Study 1 - Open Standard Case Study 2 - Linux - The Operating System – an Overview, Linux Basics, Various Linux distributions available, Preparing for Installation – Installation Checklist, Hardware Requirements, Partitioning, Installation problems ,Working with the System, Shells and Utilities, Linux commands, File Handling using vi editor, Getting familiar with shell scripts	13

Text Books:

- Introduction to Open Source Software & Open Standards (IBM ICE Publication)

Reference Books:

- Handbook of Research on Open Source Software: Technological, Economic, and Social Perspectives by Kirk St. Amant and Brian Still - IGI Global © 2007.
- Open Source: Technology and Policy by Fadi P. Deek and James A. M. McHugh - Cambridge University Press © 2008.
- Perspectives on Free and Open Source Software by Joseph Feller, Brian Fitzgerald, Scott A. Hissam and Karim R. Lakhani (eds) The MIT Press © 2005.
- Understanding Open Source and Free Software Licensing First Edition, Annotated by Andrew M. St. Laurent

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: The student will be able to

- CO1: Explain Open Source Software and the History of Open Source Software.
- CO2: Explain Application Software and Open Source Software Assessment.

- CO3: Understand the basics of open Standards.
- CO4: Understand the reason associated with open source Adoption.
- CO5: Implement the shell commands and shell scripts.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO1,PO2/PSO1
CO3	PO1/PSO2
CO4	PO4/PSO3
CO5	PO3/PSO2,PSO4

BCSC 0601 WEB PROGRAMMING THROUGH PHP & HTML

Objective: *This course introduces the building of dynamic web solutions using PHP programming and OO concepts and its connectivity with database.*

Credits: 03 **Semester II** **L–T–P-J: 3–0–2-0**

Module No.	Content	Hours
I	**Introduction to Client Server Architecture**: Components of Client-Server Application, Client-Server Models and their Benefits, Characteristics of Web Projects, Static V/s Dynamic Websites and Web Portal. **Web Servers:** Introduction to prominent Web Servers, Installation of WAMP/XAMPP and Eclipse IDE **Client Side Implementation**: Introduction to HTML, Formatting tags, Meta, Anchor, List, Table, Headers, Frames and iframes, Image, Form, Fieldset, Legend, and other tags, their usage and implementation, Introduction of Formatting using CSS, Basics of Javascript, Statements, Functions in Javascript, Integrating Javascript with Various Elements of HTML, Validating a form using Javascript. **DOM:** Introduction, Methods and Properties and their usage. **PHP Basics**: Introduction to PHP, Basic Syntax of PHP, Embedding PHP in HTML, Comments, Variables, Constants, Managing Variables, Operators and Operator Precedence and String Manipulation functions. **Conditional Control Structures:** If statement, If- else statement, If- else if statement, Nested If, Switch statement. **Looping Control Structures:** For loop, While loop, Do- While loop, For-each, Break and Continue. **Functions in PHP**: Functions, User-Defined function, Call by value and call by references, Understanding variable scope, Global Variables, Static Variables, Include and Require, Built-in functions in PHP.	20
II	**Arrays**: Arrays and its types in PHP, Accessing Elements of an Array, Modifying Elements of an Array, Functions in array, Array Sorting, Multidimensional Array. **PHP File Handling:** Introduction, File Open, File Creation, Writing to files, Reading from File, Searching a record from a file, Closing a File. **Class and Object:** Introduction, Object, Class, Defining Class in PHP, Object in PHP, Usage of this variable, Constructor, Constructor with Parameters. **Exception Handling**: Introduction to Exception, Exception Handling mechanisms, Creating Custom Exceptions, Multiple Catch Blocks, Exception Propagation, Error Handling in PHP. **Form Handling and Session Management in PHP**: Accessing and displaying Form data from different Form components, Differences among $_GET, $_POST and $_REQUEST variables, Session management, Session operations, Session tracking mechanism, Clearing/Modifying data from session, Destroying a session, Setting and Retrieving Cookies, Uploading a file, displaying its details, restricting various details of a file during upload, checking for errors and reading Error code table. **Database Management**: Introduction to DBMS, SQL Basics, Database connectivity in PHP with MySQL, Executing Queries from frontend, **XML:** Introduction to XML, Parsing XML document using DOM parser, Various operations on XML document using PHP.	20

Reference Books:

- IBM Student Guide on “Web Programming through PHP & HTML”

- Robin Nixon: "Learning PHP, MySQL and JavaScript" "O'Reilly Media, Inc.", July 2009.
- Dave W Mercer, Allan Kent, Steven D Nowicki, David Mercer, Dan Squier, Wankyu Choi – Beginning PHP, Wiley Publishing, Inc
- Ivan Bayross - "HTML, DHTML, JavaScript, Pearl & CGI", Fourth Revised Edition, BPB Publication
- "Programming PHP", RasmusLerdorf and Kevin Tatore, Shroff Publishers & Distributors Pvt.Ltd

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: Upon completion of this course, the students will be able to:

- CO1: Understand the basics of client server architecture and its components.
- CO2: Explain the basics of web development using PHP and HTML.
- CO3: Develop a program using functions, control structures and array.
- CO4: Demonstrate the concepts of object and exception handling in PHP.
- CO5: Demonstrate web application using PHP,XML and MYSQL.
- CO6: Develop a dynamic/ static websites with server side programming.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1, PSO1
CO2	PO1, PSO2
CO3	PO3, PSO2
CO4	PO4, PO2, PSO4
CO5	PO4, PO5, PSO4
CO6	PO3, PSO4

BCSG0800: PYTHON PROGRAMMING LAB

Objective: *This course introduces the solving of problems using Python programming using OO concepts and its connectivity with database.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	Programs based on the concepts of: • Building Python Modules • Obtaining user Data • Printing desired output Programs based on the concepts of: • Conditional if statements • Nested if statements • Using else if and elif Programs based on the concepts of Iteration using different kinds of loops Usage of Data Structures • Strings • Lists • Tuples • Sets • Dictionary Program based on the concepts of User-defined modules and Standard Library (random, numpy, scipy, sys, Math Module, String Module, List Module). Program based on Input Output. Program based on exception Handling. Program based on Simple Data analysis. Program based on Pandas.	26

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: By the end of the course, students will learn to:

- CO1: Apply OO concepts using Python programming.
- CO2: Apply in-built packages defined in Python.
- CO3: Apply front-end as Python Programming to connect with any back-end.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO4
CO3	PO5/PSO2

BCSC0800: COMPUTER PROGRAMMING LAB

Objective: *The objective is to provide a comprehensive study of the C programming language. It stress the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	• Mapping of flow chart, Algorithm, Language • Simple C-program execution • Programs based on various operators • Programs based on Decision and case Control Structure • Programs based on Loop Control Structure • Program based on special control statement ➢ break ➢ continue • Programs based on Array Insertion, Deletion, Linear Search & Bubble Sort • Programs based on String ➢ Length, Copy, Reverse, Concatenate, Compare with & without built-in functions • Programs based on Functions. • Programs based on Storage Class. • Programs based on Recursion. • Programs based on Preprocessor. • Programs based on Pointers • Programs based on array • Programs based on string • Programs based on call by value and call by reference • Programs based on Dynamic Memory Allocation • Programs based on User Defined Data types ➢ Structure and Union ➢ Enum and Typedef • Programs based on File handling ➢ Opening a file ➢ Reading, writing and appending a file ➢ Closing file ➢ Random Access to Files of Records • Programs based on Command Line Argument.	52

Reference Books:

- Herbert Schildt, "C: The Complete Reference", 5th Edition, McGraw Hill Education
- K. N. King, "C Programming a Modern Approach", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, "The C Programming Language", PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: On Completion of this course, students are able to:

- CO1: Design programs involving decision structures, loops and functions.
- CO2: Understand the concepts of functions, recursion, pointers and file handling.
- CO3: Design programs involving structures, union and functions.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO3,PO4/PSO1
CO3	PO3/PSO2,PSO4

BCSC0801: OBJECT ORIENTED PROGRAMMING LAB

Objective: *The objective of this course is that students will study and learn Object Oriented Modeling and programming.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	Programs in Java and python based on the concepts of: • Classes, Constructors, Polymorphism and Keyword Static. Programs based on the concepts of: • Inheritance, Multithreading Using Thread Class & Interface Runnable, String Handling, Generic Classes. Programs based on the concepts of: • Handling Database Connectivity. • Implementation of Collection Framework. Programs based on the concepts of: • Database Connectivity. • Retrieving Data from Database. • Parameters Passing, Execute many Method. • Cursor Attributes. • Invoke Stored Procedures. • Invoke Stored Functions.	24

Reference Books:

- Naughton, Schildt, "The Complete Reference JAVA2", 9th Edition, Oracle Press.
- Bhave & Patekar, "Programming with Java", Pearson Education
- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, the student will be able to:

- CO1: Implement object oriented language features.
- CO2: Design GUIs and Graphical programming.
- CO3: Design object oriented solutions for small systems involving database and event handling concepts.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO5/PSO2
CO3	PO3,PO5/PSO4

BCSC0802: DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Generation of database report,.	24

References Books:

- Date C J,” An Introduction to Database Systems”, 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , “Database Concepts”, 5th Edition, TMH, 1998.
- Majumdar& Bhattacharya, “Database Management System”, TMH

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Develop the SQL queries for real life scenarios.
- CO3: Implement the procedural language (PL/SQL) and Triggers.

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Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO1,PO2/PSO1,PSO4
CO3	PO2,PO3,PO5/PSO2,PSO3

BCSC0803: OPERATING SYSTEMS LAB

Objective: *The lab aims to develop understanding the operation of UNIX operating system.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implement the following basic commands (with options) used in UNIX/LINUX OS. • Write and implement the basic vi editor commands. • Shell scripts that use simple commands. • Decision based Shell scripts. • Shell scripts related to strings. • Shell scripts using pipes. • Shell scripts with loop statements. • Demonstration and solution for race condition. • Demonstration and use of System Calls. • Implement the basics of IPC in UNIX. • Implementation of Classical Problem in Concurrency	24

Reference Books:

- Sibsankar Halder and Alex a Aravind , "Operating Systems", 6th Edition, Pearson Education 2009.
- Harvey M Dietel "An Introduction to Operating System", 2nd Edition, Pearson Education 2002.
- D M Dhamdhere "Operating Systems: A Concept Based Approach", 2nd Edition 2006.
- M. J. Bach. "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, the student will be able to:

- CO1: Implement the basic operations on UNIX operating systems.
- CO2: Demonstrate the working of systems calls.
- CO3: Demonstrate message passing in Unix operating system.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO4,PO5/PSO1,PSO2

BCSC0804: COMPUTER ORGANIZATION LAB

Objective: *The aim of the lab is to better understand the design of sequential Circuits such as Flip-Flops, Registers, and Counters.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• Bread Board Implementation of Flip-Flops. • Experiments with clocked Flip-Flops. • Design of Counters. • Bread Board implementation of Counters &Shift Registers. • Implementation of Arithmetic Algorithms. • Bread Board implementation of Adder/Subtraction (Half, Full). • Bread Board implementation of Binary Adder. • Bread Board implementation of Seven Segment Display. • Small Project based on combinational and sequential circuit. • Verify the excitation tables of various FLIP-FLOPS . • Design of an 8-bit ARITHMETIC LOGIC UNIT. • Design of 24x8 (16 byte) RAM. • Design of 24x8 (16 byte) STACK. . Implementation of a 4-bit PROCESSOR.	24

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4thEdition, Elsevier Publication, 2008.
- William Stalling , "Computer Organization",8th Edition, PHI, 2011.
- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After the completion of the course, the student will be able to:

- CO1: Implement the Combinational and Sequential Circuit.
- CO2: Demonstrate the working of counter and shift register.
- CO3: Demonstrate the working of ALU and seven segment displays.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO5/PSO2
CO2	PO3,PO4/PSO2
CO3	PO3,PO5/PSO1,PSO2

BCSC0805: DATA STRUCTURES & ALGORITHMS LAB

***Objective**: The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module		Lab
I &II	• Program to implement various operations in a singly linked list. • Program to implement insertion, deletion and traversal in a doubly linked List. • Program to implement polynomial addition using linked list. • Program to demonstrate the various operations on stack. • Program to convert an infix expression into postfix expression. • Program to evaluate a given postfix expression. • Program to implement Tower of Hanoi problem using Recursion. • Program to demonstrate the implementation of various operations on linear and circular queue. • Program to demonstrate the implementation of insertion and traversals on a binary search tree. • Program to implement Dijkstra's Algorithm to find the shortest path between source and destination. • Program to search a given element as entered by the user using sequential and binary search to search a given element as entered by the user. • Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort. • To write the following recursive functions for a singly-linked NULL-terminated list: insert(), traverse(), search().	24

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

BCSC0806: MICROPROCESSORS LAB

Objective: *The objective is to introduce the Architecture and programming of the microprocessor and learning about interfacing and various applications of microprocessor.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• To study 8085 microprocessor System. • To study 8086 microprocessor System. • To develop and run basic programs in 8085 ALP. • To develop and run programs in 8085 ALP related to the concept of looping, counting and indexing. • To perform interfacing of RAM chip to 8085/8086. • To perform interfacing of keyboard controller. • To perform interfacing of DMA controller. • To perform interfacing of UART/USART.	24

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- D. V. Hall , "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the arithmetic and logical operations using assembly language programming (8085).
- CO2: Demonstrate the memory operations using assembly language programming (8085).
- CO3: Demonstrate the interfacing of Keyboard, DMA and UART controller.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO2/PSO1,PSO2
CO3	PO1,PO3,PO5/ PSO2

BCSC0807: DESIGN & ANALYSIS OF ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implementation of sorting algorithms: ○ Insertion Sort ○ Bubble Sort ○ Selection Sort ○ Divide and conquer approach: • Quick Sort • Merge Sort ○ Heap Sort ○ Counting Sort • Implementation of Searching Techniques: ○ Linear Search ○ Binary Search • Implementation of Matrix Multiplication • Implementation of Convex Hull • Implementation of Breadth First Search • Implementation of Depth First Search • Implementation of Greedy approaches: ○ Optimal Reliability Allocation. ○ Knapsack. Minimum ○ Minimum Spanning trees: • Prim's and Kruskal's algorithms. ○ Single source shortest paths – • Dijkstra's and Bellman Ford algorithms. • Implementation of Dynamic Programming: ○ Longest Increasing Subsequence. ○ Finding best path in maze. ○ Matrix Chain Multiplication ○ 0/1 Knapsack Problem ○ Resource Allocation Problem	32

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.
- CO2: Demonstrate and use the appropriate data structures for a given problem
- CO3: Implement the algorithms based on Greedy approach and Dynamic Programming.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO1,PSO2,PSO4
CO2	PO1,PO3,PO4/PSO1,PSO2,PSO3
CO3	PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0900: WEB PROGRAMMING THROUGH PHP & HTML LAB

Objective: *This course introduces the building of dynamic web solutions using PHP programming and OO concepts and its connectivity with database.*

Credits: 01 **Semester IV** **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I&II	Static web applications using HTML/CSS Web applications using HTML & Javascript Programs using Decision Control Structures Programs using Loop Control Structures Programs using user defined functions Programs of Array handling and manipulation Programs of File handling and manipulation Programs using OO concepts in PHP Web applications with Form handling at server Web applications for managing sessions Web applications with connectivity with MySQL Web applications manipulating XML file	24

Reference Books:

- IBM Student Guide on "Web Programming through PHP & HTML"
- Robin Nixon: "Learning PHP, MySQL and Javascript" "O'Reilly Media, Inc.", July 2009.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Design websites with interactive web page(s) using HTML, CSS and JavaScript
- CO2: Design a responsive web site using HTML and CSS.
- CO3: Develop simple web application using server-side PHP programming with backend as MySQL.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO5/PSO1,PSO2

Program Elective (Only for Specialization Programme)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Data Analytics									
THEORY									
1.	BCSE0551	Introduction to Business Analytics	3	0	0	0	3	3	
2.	BCSE0552	Applied Statistical Analysis	3	0	0	0	3	3	Introduction to Business Analytics
3.	BCSE0553	Data Mining and Predictive Modeling	3	0	0	0	3	3	Applied Statistical Analysis
4.	BCSE0554	Data Warehouse & Multidimensional Modeling	3	0	0	0	3	3	Data Mining and Predictive Modeling
5.	BCSE0555	Business Intelligence	3	0	0	0	3	3	
6.	BCSE0556	Hadoop & Big Data Analytics	3	0	0	0	3	3	Data Warehouse & Multidimensional Modeling
7.	BCSE0557	Social, Web & Mobile Analytics	3	0	0	0	3	3	Hadoop & Big Data Analytics
PRACTICALS									
1.	BCSE0581	Applied Statistical Analysis Lab	0	0	2	0	1	2	
2.	BCSE0582	Data Mining and Predictive Modeling Lab	0	0	2	0	1	2	
3.	BCSE0583	Data Warehouse Lab	0	0	2	0	1	2	
4.	BCSE0584	Business Intelligence Lab	0	0	2	0	1	2	
5.	BCSE0585	Hadoop & Big Data Analytics Lab	0	0	2	0	1	2	
6.	BCSE0586	Social, Web & Mobile Analytics Lab	0	0	2	0	1	2	
Total			**21**	**0**	**12**	**0**	**27**	**33**	

BCSE0551: INTRODUCTION TO BUSINESSANALYTICS

Objective: *This course provides introductory knowledge of Business Analytics.*

Credits: 03 **Semester III** **L–T–P-J: 3–0-0-0**

Module No.	Content	Teaching Hours
I	**Business Analytics and Optimization:** Introduction to Business Analytics and Optimization, Challenges - Volume, Variety (Diversity), and speed of Data Creation (and needed decisions), Approaches to help maximize profitability and returns, Business Analytics Capabilities, Enterprise Analytics Capabilities, Business Analytics Technologies, Predictive Analytics, Prescriptive Analytics, A fact-based decision making culture, A strong data infrastructure, The Right Analytical Tools, Analytics Workforce, Knowledge Requirements, Business Analyst, Data Scientist, Where to put the analytics team, IBM Business Analytics Maturity Model, Optimization, Key BAO Concepts, The need for BAO now, Essential Capabilities In BAO, BAO Capabilities: Business Performance Management, Predictive Analysis and Mining, Value of BAO to Business Organization, Impact of BAO on diverse industries, Advantages to implementingBAOsolutions,BAOCapabilities:Real-timeAnalytics:DataInMotion, BAO support for decision-making, High level architecture of BAO, Importance of reference architecture, BAO reference architecture, BAO reference architecture to BAO architects, IBM Technology Portfolio forBAO. **Data Warehouse:** Decision Support ,Three Tier Decision Support Systems, Exploring and Analyzing Data, What is a data warehouse? Data warehouse architecture choices, Enterprise data warehouse, Independent data mart architecture, Dependent data mart architecture, Data Warehouse, Data warehouse usage, Multidimensional Data, Conceptual Modeling of Data Warehouses, The “Classic” Star Schema, The “Snowflake” Schema, The “Fact Constellation” Schema, Data Warehouse Design Process, Single-Layer Architecture, Two-Layer Architecture, Three-Tier Data Warehouse Architecture, Data Warehouse Development, Multi-Tiered Architecture, Information pyramid, BI reporting tool architectures, Types of BI users, Multidimensional analysis techniques, Data Analysis and OLAP, OLAP Server Architectures, Data Cube, Discovery-Driven Data Cubes, OLTP vs. OLAP, Business Query, Dashboards and Scorecards Development, Metadata Model, Automated Tasks and Events, Mobile BI, Disconnected BI, Collaborative BI, Real-time Monitoring, Software Development Kit(SDK),Setting updata for BI ,Making BIeasy to consume. **Business Intelligence:** Definitions of Business Intelligence, Sample BI Architecture, Things are getting more complex, BI Components and Architecture, Scope and fit of BI solutions with in existing infrastructure ,High Level BIProcess, Functional Areas of BI Tool, A single or a few applications, Benefits of BI, Maximize Value from BI Systems, Strategy and Business Intelligence, Business Transformation Projects, Business Roleof BI(TWDI),ASUG Business Intelligence Maturity Model ,Why Act? BI Effectiveness Scorecard, BI Value Scorecard, Five key areas of strategy, Planning a BI Project, Pre- Engagement Activities, Engagement Activities and process, BI Design and Development, Business Environment, Project Tasks: Task 1- Knowledge Capture Goals - Discuss Business Objectives & Prior Learning, Interview key stakeholders, Project Planning, Task 2 - Consolidate Findings - Create logical design, Task 3 - Map the Customer Situation - Current Environment, Business/Functional Requirements Sample Diagram, Logical BI Diagram, Task 4 -Methodology & Approach,Task5-Standards & Governance, Task6-Sections, Milestones and Tasks, Task 7 – Proof of Concept (POC), Task 8 – Table Creation, Task 9 – OLAP Creation, Task 10 –Final Deliverables, Risk management and mitigation, Cost justification and measuring success.	20

II	**DataMining:**What is Data Mining ,Evolution of Data Mining, and Why Data Mining? Knowledge Based System, Data Mining Process, Phases of Data Mining Process, KDD Process Model, CRISP - DM, CRISP-DM - Elaborate view, Data Mining – On what kinds of Data? DM Tasks and Components of DM methods, Data mining operations, Data mining techniques, Industry examples of application of DM, Challenges of Data Mining, and Why Machine should "Learn"? Machine Learning, Growth of Machine Learning, Machine Learning types, Unsupervised learning, Reinforcement Learning. **Dashboard & Report Designing:** Definition, Dashboard Types, Evolution of Dashboards, Layers of Information, Dashboard Design, Dashboard Design Principles, Other Dashboard Examples, Display Media for Dashboards, Chart Overview, Singular Components, Metrics, Metrics drive behavior in a number of ways, Kaplan-Norton Balanced Scorecard, The Rayport-Jaworski Performance Dashboard and Strategy Framework, Introducing the R-J Performance Dashboard, Blueprint to the R-JPerformance Dashboard, Building Reports, ListReport, Crosstab Report, Chart Report, Map Report, Data group, sort and Filters, add calculations to report, Conditions and Aggregations in Report, Drilling in report ,Run report–on demand or schedule ,Charts, ChartType–Bar Chart ,Line ,Pie ,Area ,Scatter and all other charts and types of charts. **Big Data Analytics:** Introduction to Big Data, Need for Big Data, Characteristics of Big Data, Structure of Big Data and need for standards, Big Data Analytics Adoption, Benefits & Barrier of Big Data Analytics, Trends for Big Data Analytics, Commoditization of Hardware Enabling New Analytics ,Analytics and Techniques ,Big Data Platform and Application Frameworks, Manifesto, Big Data UseCases.	20

Text Books:

- Introduction to Business Analytics (IBM ICE Publication)
- Fundamentals of Business Analytics by R N Prasad, Seema Acharya, Wiley India, 2012.

Reference Books:

- Leskovec , Jure, Anand Rajaraman, and Jeffrey David Ullman. Mining of massive datasets. Cambridge University Press, 2014.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Understand the use of reference architecture in business analytics.
- CO2: Explain the decision support science and data warehouse.
- CO3: Understand the concepts of Business Intelligence.
- CO4: Explain the KDD in data mining.
- CO5: Understand the process of analysis using Dashboards and Reports.
- CO6: Explain Big Data, Filtering BigData and Adoption Architecture.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO3/PSO2
CO2	PO4/PSO3
CO3	PO5/PSO2
CO4	PO2/PSO1
CO5	PO1/PSO4
CO6	PO3/PSO2

BCSE0552: APPLIED STATISTICAL ANALYSIS

Objective: *This course provides the knowledge about the statistical methods and implementation using software(e.g,R).*

Credits: 03 **Semester IV** **L–T–P-J: 3–0–2-0**

Module No.	Content	Hours
I	**Introduction to Statistical Analysis**: What is statistics? Types of Statistics, Population vs Sample, basic terminology, Measurement & Scaling: characteristics **Variables**: Nominal and Ordinal, Interval & ratio scales, Quantitative variables, Qualitative or categorical variables. **Data**: Sources of Data, cross-section data, Time-series data. **Measures of central tendency**: Mean, Outlier, Median, Mode, Left & Right Skewness, Measure of spread, Range, Variance and Standard deviation. **Population parameters & Sample Statistics**: Measures of position-quartiles and interquartile range, Quartiles, Percentiles and percentile rank, Box & Whisker Plot. **Describing Data & Probability**: Raw Data, Graphical presentation of qualitative data, Graphical quantitative data, Frequency distributions, relative frequency and percentage distributions, Graphing grouped data, Cumulative frequency distributions, Probability concepts, Simple and compound events, Two properties of probability, Classical probability, Complementary events, Discrete Random Variables. **Probability Distributions:** The Binomial experiment, Poisson Probability distribution, Continuous random variables, Normal Distribution.	20
II	**Testing Hypothesis:** Population distribution, Sampling and Non sampling Errors, point estimate, Interval estimation, The *t* Distribution, Testing Hypothesis, Chi-Square Distribution, The F-Distribution **Examining Relationship:** Covariance, Pearson correlation coefficient, Computing a correlation, Hypothesis test for a correlation, Correlation coefficient, correlation analysis, Scatter plots, Relationships between continuous variables, Correlation, Extreme data values, Correlation Matrix, ANOVA, Regression. **Advanced Techniques:** Non Parametric tests, Chi-squared goodness-of-fit test, Chi-square test of independence, the sign test, Mann-Whitney test, Kruskal-Wallis test, Structural equation modelling, Cluster analysis, Factor analysis, Centroid method, Principal Components method, Maximum Likelihood Method	20

Reference Books:

- IBM Student Guide on "Applied Statistical Analysis"
- G. Jay Kerns: "Introduction to Probability and Statistics Using R", 2014.

Focus: This Course focuses on Employability under CO1, CO2,CO3,CO4 & CO5.

Outcome: After completion of course, student will be able to:

- CO1: Understand the different variables measurement and scaling.
- CO2: Analyze the different central tendency operations.
- CO3: Demonstrate the different ways to represent the data.
- CO4: Analyze the hypothesis testing using different estimation and distribution methods.
- CO5: Analyze the correlation and regression for the real world problem data.
- CO6: Analyze the data using the advanced techniques like , Chi-squared goodness-of-fit test, Chi-square test of independence, the sign test and Mann-Whitney test.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO1/PSO3
CO3	PO2/PSO4
CO4	PO1/PSO4
CO5	PO3/PSO1
CO6	PO1/PSO4

BCSE0581: APPLIED STATISTICAL ANALYSIS LAB

Objective: *This course introduces students to R, a widely used statistical programming language. Students will learn to manipulate data objects, produce graphics, analyze data using common statistical methods, and generate reproducible statistical reports. Student will also learn data mugling*

Credits: 01 **Semester VI** **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I&II	• Introduction and Basics • Data frames, functions, loops, if/else • Importing Data in R • Handing Numerical and categorical variables • Data manipulation in R • Data Preprocessing in R • Probability Distribution in R • Statistical tests and models • Correlation & Regression • Nonparametric tests	

Reference Books:

- Paul Teetor. R Cookbook: Proven recipes for data analysis, statistics, and graphics. O'Reilly Media, Inc., 2011.
- Norman Matloff. The art of R programming: A tour of statistical software design. No Starch Press, 2011.
- Winston Chang. R graphics cookbook. O'Reilly Media, Inc., 2012.
- Hadley Wickham and Garrett Grolemund. R for data science, 2016.
- Phil Spector. Data manipulation with R. Springer Science & Business Media, 2008.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: After completion of course, student will be able to:

- CO1: Implement data import, data manipulation and data preprocessing using R.
- CO2: Demonstrate the statistical summaries of continuous and categorical data.
- CO3: Demonstrate the common hypothesis tests using simple regression models in R.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO5/PSO3
CO2	PO4,PO3/PSO4
CO3	PO4/PSO3

BCSE 0553: DATA MINING AND PREDICTIVE MODELLING

Objective: *The course objectives is to give the basic concepts of e data mining methods based on prediction and do the prediction modeling for finding the accuracy.*

Credits: 04 **Semester V** **L–T–P-J: 4–0–2-0**

Module No.	Content	Hours
I	**Introduction:** What Is Data Mining? Data Mining and Related Terms, Knowledge based System, KDD Process Model, CRISP - DM, Terminology and Notation, **The Steps in Data Mining:** Data Preparation, Data Understanding, Data Cleaning, Missing data, Coding Systems, Discretization , Univariate Data Analysis **Core Ideas in Data Mining**: Classification, Prediction, Association Rules and Recommendation Systems, Predictive Analytics, Data Reduction and Dimension Reduction, Data Exploration and Visualization, machine Learning: Growth and Applications, Supervised and Unsupervised Learning, Reinforcement Learning **Unsupervised Learning Models**: **Association Rules**: Introduction, Discovering Association Rules in Transaction, Databases, Generating Candidate Rules, Selecting Strong Rules **Data Visualization:** Uses of Data Visualization, Basic Charts: bar charts, line graphs, and scatterplots, Boxplots and Histograms, Heat maps, Multidimensional Visualization, Specialized Visualizations, Summary of major visualizations and operations **Supervised Learning Models and Techniques**: **The Naive Bayes Classifier** Conditional Probability, Applying the Full (Exact) Bayesian Classifier, Advantages and Shortcomings ,**Multiple Linear Regression**: Estimating the Regression Equation and Prediction, Variable Selection, **Classification and Regression Trees**: Introduction, Measures of Impurity, Evaluating, Avoiding Overfitting , Classification Rules from Trees, Classification Trees for More Than Two Classes, Regression Trees, **Evaluating Predictive Performance:** Introduction, Evaluating Predictive Performance, Judging Classifier Performance: Confusion Matrix, K-S Chart, Judging Ranking Performance: Lift and Gain Charts, ROC, AUC, Model Evaluation of Regression: BIC, AIC, Cross Validation,	20
II	**Logistic Regression**: Model with a Single Predictor, Estimating the Logistic Model from Data, Interpreting Results in Terms of Odds, Evaluating Classification Performance, Variable Selection, Data Preprocessing, Model-Fitting and Estimation, Model Interpretation, Model Performance, **Cox Regression** **Cluster Analysis:** Introduction, Measuring Distance Between Two Records, Measuring Distance Between Two Clusters, Hierarchical (Agglomerative) Clustering, k-Means Algorithm **Dimension Reduction**: Introduction, Curse of Dimensionality, Practical Considerations, Data Summaries, Correlation Analysis, Reducing the Number of Categories in Categorical Variables, Converting Categorical to Numerical Variable, PCA, Dimension Reduction Using Regression Models and Classification and Regression Trees, Data Partitioning, Model Selection, Link Analysis, Clustering **Time Series**: Handling Time Series, Regression-Based Forecasting, Smoothing Methods **Artificial Neural Networks**: Concept and Structure of a Neural Network, Fitting A Network to Data, Required User Input, Exploring The Relationship Between Predictors and Response, Advantages and Weaknesses of Neural Networks **Discriminant Analysis:** Introduction, Distance of an Observation from a Class, Fisher's Linear Classification Functions, Classification performance of DA, Prior Probabilities, Unequal Misclassification Costs, Classifying more Than Two Classes, Advantages and Weaknesses	20

Text Books:

- IBM Student Guide on “Data Mining and Predictive Modelling”.
- Data Mining for Business Analytics: Concepts, Techniques, and Applications in R by GalitShmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl, Jr., Wiley, 2018

Reference Books:

- Data Mining and Business Analytics with R by Johannes Ledolter 2013
- Data Mining: Concepts and Techniques ByJiawei Han, MichelineKamber, Jian Pei 2011
- Introduction to Data Mining By Pang-Ning Tan 2018
- A User's Guide to Business Analytics By Ayanendra nath Basu, SrabashiBasu · 2016

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Understand the basic concepts of KDD in data mining.
- CO2: Apply visualization methods for evaluating predictive models and the presentation of analytical results.
- CO3: Explain the supervised and unsupervised learning methods and their applications.
- CO4: Categorize and elucidate appropriate data mining approaches for problems relating to predictive modeling.
- CO5: Applying the methods to actual quantitative data and interpreting the results of the analysis.
- CO6: Explain the concepts dimension reduction for better result interpretation.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2,PO3/PSO4
CO3	PO1/PSO3
CO4	PO4/PSO4
CO5	PO2,PO4/PSO3
CO6	PO2/PSO3

BCSE0582: DATA MINING & PREDICTIVE MODELING LAB

Objective: *This course provides introductory knowledge to Rattle Tool for Data Mining.*

Credits: 01 **Semester V** **L–T–P-J: 0–0–2-0**

M000odule No.	Content	Teaching Hours
I&II	• Introduction to Rattle, Rattle Interface Tabs: Data, Explore, Test, Transform, Cluster Analysis, Association Analysis, Model and Evaluate Tab. • Reading Data Files: free field text files, statistics data files, databases using ODBC, Excel file, Viewing and Manipulate Data Files and R Objects. • Understanding missing data in R Studio, examining the distributions of categorical and continuous fields, imputing missing values in Rattle. • Outliers and Anomalous data • Data Manipulation • Looking for Relationships in Data • Selecting, Sampling and Partitioning Records • Modeling Techniques in RStudio • Comparing and Combining Models	4

Text Books:
- Data Mining and Predictive Modeling(IBM ICE Publication)
- Data Mining and Business Analytics with RBy Johannes Ledolter

Reference Books:
- R for Demmies by Andrie and Joris, Wiley Publication

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Understand the use of Rattle Tool used for Data Mining.
- CO2: Design different modelsfor Analytics and Prediction.
- CO3: Implement to detect & deal with outliers, missing values.
- CO4: Evaluate the performance of different analytical models.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO3/PSO2
CO3	PO4,PO5/PSO4
CO4	PO4/PSO3

BCSE 0554:DATA WAREHOUSE & MULTIDIMENSIONAL MODELING

Objective: *The course objectives give the basics of the data warehousing, Multi-dimensional modeling including R-OLAP and M-OLAP.*

Credits: 03 **Semester VI** **L–T–P-J: 3–0–2-0**

Module No.	Content	Hours
I	**Introduction:** What Is a Data Warehouse? Role and Purpose of the Data Warehouse, The Multipurpose Nature of the Data Warehouse, Characteristics of a Maintainable Data **The Data Warehouse Data Model**: Non redundant, Stable, Consistent, The Codd and Date Premise Impact on Data Mart Creation **Fundamental Relational Concepts:** Why Do You Need a Data Model? Relational Data-Modeling Objects, **Types of Data Models-** Subject Area Model, Business Data Model and System Model. **Normalization of the Relational Data Model Model Development - Understanding the Business Model** **Developing the Model:** Methodology, - Select the Data of Interest, Add Time to the Key, Add Derived Data, Determine Granularity Level, Summarize Data, Merge Entities, Create Arrays, Segregate data. **Creating and Maintaining Keys –** **Business Scenario** - Inconsistent Business Definition of Customer, Inconsistent System Definition of Customer, Inconsistent Customer Identifier among Systems, **Inclusion of External Data-** Data at a Customer Level, Data Grouped by Customer Characteristics. **Data Warehouse System Model -** Inconsistent Business Definition of Customer, Inconsistent System Definition of Customer, Inconsistent Customer Identifier among Systems, Absorption of External Data, Customers Uniquely Identified Based on Role, Customer Hierarchy Not Depicted **Data Warehouse Technology Model -** Key from the System of Record, Key from a Recognized Standard, Surrogate Key. **Dimensional Data Mart Implications -** Differences in a Dimensional Model, Maintaining Dimensional Conformance	20
II	**Modeling the Calendar:** Calendars in Business, Time and the Data Warehouse, Case Study: Simple Fiscal Calendar, Case Study: A Location Specific Calendar **Modeling Hierarchies:** Hierarchies in Business, The Nature of Hierarchies, Case Study: Retail Sales Hierarchy, Case Study: Sales and Capacity Planning **Modeling Transactions:** Business Transactions, Application Interfaces, Delivering Transaction Data **Modeling Transactions:** Case Study: Sales Order Snapshots, Case Study: Transaction Interface **Data Warehouse Optimization**: Optimizing the Development Process, Optimizing the Database, **Optimizing the System Model- Vertical Partitioning**, Vertical Partitioning for Performance, Vertical Partitioning of Change History, Vertical Partitioning of Large Columns, **Denormalization, Subtype Clusters.** **Operation and Management: Accommodating Business Change -** The Changing Data Warehouse, Reasons for Change, Controlling Change, Implementing Change. **Modeling for Business Change -**Assuming the Worst Case, Imposing Relationship Generalization, Using Surrogate Keys, **Implementing Business Change** **Maintaining the Models - Governing Models and Their Evolution -** Subject Area Model, Business Data Model, System Data Model, Technology Data Model, Synchronization Implications, **Model Coordination -** Subject Area and Business Data Models, Color-Coding, Subject Area Views, Including the Subject Area within the Entity Name, Business and System Data Models, System and Technology Data Models.	20

Reference Books:

- IBM Student Guide on "Data Warehouse and Multi-Dimensional Modeling".
- DB2 Universal Database Developers Guide by Roger E. Sanders
- Building the Data Warehouse by W.H. Inmon.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Understand the functionality of the different data mining and data-warehousing component.
- CO2: Explain different data models.
- CO3: Understand the concepts of different data Warehouse technology models.
- CO4: Explain the different data Warehouse optimization models.
- CO5: Understand the different operation and managements in data Warehouse.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO1,PO2/PSO3
CO3	PO5,PSO1
CO4	PO1,PO3,PSO4
CO5	PO11,PO9,PSO1

CSE 0583 Data Warehouse Lab

Objective: *This course provides introductory knowledge to IBM INFOSPHERE DATA ARCHITECT Tool and Toadstool for Data Warehousing.*

Credits: 01 **Semester VI** **L–T–P-J: 0–0–2-0**

M000odule No.	Content	Teaching Hours
I& II	• Understand the detailed steps involved in Normalization processby converting the main relation into multiple relations in DB2 • A Datawarehouse project for a chain of home entertainment retail stores. • Understand the Multi-Dimensional modeling aspects in a Datawarehouse Environment. • Understand OLAP queries, Materialized query tables, Summary tables and staging tables. • To implement a complete Datawarehouse environment in Infosphere Data Architect. • To install and learn Toad tool for DataWare housing. • To design and understand Multi-Dimensional schemas in Toad. • To connect Toad with oracle and develop a simple PL/SQL unit test using Toad • Learn to manage large amount of data and manage multiple media, Efficient Loading of Data, Efficient Indexing. • Drill-Down Analysis, Event Mapping, Modeling and External/Unstructured Data • Moving Data from the Web to the Data Warehouse, Moving Data from the Data Warehouse to the Web, ERP Applications Outside the Data Warehouse, Building the Data Warehouse inside the ERP Environment. • The ERP-Oriented Corporate Data Warehouse, When to Do Design Review	4

Text Books:

- Data Warehousing and Multi-Dimensional Modeling (IBM ICE Publication)

Reference Books:

- Building the Data warehouse by W.H. Inmon.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Understand of IBM Infosphere Data Architect and Toad Tool used for Data Warehousing.
- CO2: Design and execute ETL processes.
- CO3: Select best schema with respect to data warehouse design.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO5, PSO2
CO2	PO3,PO2, PSO3,PSO2
CO3	PO2,PSO4

BCSE0555: BUSINESS INTELLIGENCE

Objective: *The course objectives is to give the basics of the Business Intelligence and reporting techniques to different data types.*

Credits: 03 **Semester VI** **L–T–P-J: 3–0–0-0**

Module No.	Content	Hours
I	**Introduction to Business Intelligence**: What is Business Intelligence? Definition of Business Intelligence, what is Analytics? Types of Analytics: Descriptive, Prescriptive, Predictive. Sample BI Architecture BI Components and Architecture Complex System Vs Volume Operations Enterprise Analytical Capabilities. Alignment between IT and Business **Decision Support System:** Decision Support System**,** Three Tier Decision Support system**,** Exploring and analyzing data, OLAP and Advanced Analytics **Data Warehouse:** What is Data Warehouse? Data Warehouse –Subject Oriented, Integrated, Time Variant, Non Volatile, Multidimensional Data Conceptual Modeling of Data Warehouse Data Warehouse Design Process, Multi-Tiered Data Warehouse Architecture, Data Warehouse Development, Data Cubes, DataMart, Discovery Driven Data Cubes **Dimensional Modeling:** Dimension, Hierarchies on Dimensions, OLAP Server Architectures Typical OLAP Operation, OLTP vs. OLAP, Mobile BI, Disconnected BI, Collaborative BI , Software Development Kit.	20
II	**Building a BI Project:** Benefits of BI, Strategy and Business Intelligence, Business Role of BI, ASUG Business Intelligence Maturity Model, Measuring BI Success and value, BI effectiveness Scorecard, Planning of BI Project, BI Design and Development, Project Tasks. Risk Management and mitigation, Cost justification and Measuring success. ` **Building of Report:** What is Business Report? Metrics, Kaplan-Norton Balanced Scorecard, Limitation to the K-N Balanced Scorecard The Rayport-Jaworski Performance Dashboard and strategy Framework, Relational Reporting Style, Dimensional Reporting Style, List Report, crosstab report, chart report, Map report, Filters in Report, Drilling in report **Dashboard Design:** Definitions, Types of Dashboard, Evolution of Dashboard, Information discovery and Delivery, BI Architecture, Centralized vs Decentralized architecture, Expanding BI Potential, Data Backup and Restoring	20

Text Books:

- IBM Student Guide on “Business Intelligence”
- Swain Scheps , ”Business Intelligence for Dummies

Reference Books:

- Decision Support and Business Intelligence Systems, 9th Edition Turban, Sharda & Delen
- Business Intelligence Guidebook From Data Integration to Analytics by Rick Sherman
- Business Intelligence and Analytics by Drew Bentley
- Business Intelligence and Data Mining by Anil K. Maheshwari

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: By the end of the class, students will learn to:

- CO1: Define Business Intelligence, its components and types of Analytics.
- CO2: Applying Business Intelligence to produce Business Reports.
- CO3: Understand the concept of exploring and analyzing data that leads to effective analytics for decision-making.
- CO4: Define data Warehouse and its characteristics.
- CO5: Design data warehouse schema and data cubes using OLAP techniques.

- CO6: Design of Dashboard with multiple reports.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO3,PSO2/PSO3
CO3	PO2, PO5/PSO2
CO4	PO1,PO5/PSO3
CO5	PO5,PSO2/PSO3
CO6	PO3,PSO2/PSO4

BCSE0584: BUSINESS INTELLIGENCE LAB

Objective: *This course introduces students to Business Intelligence, Students will learn to create multiple reports and analyze data using various methods and generate Business reports. Student will also learn data representation in dimensional Modeling*

Credits: 01 **Semester VI** **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I&II	• Overview of BI Tool-Cognos Report Studio • Authoring Reports • List, Crosstab and Charts Reports • Grouping and Summarizing Data • Filtering on Reports • Sorting and calculation on Reports • Adding Prompt in Reports • Creation of Miscellaneous Reports • Scenario/ Objective Based Reports	

Reference Books:

- "Business Intelligence A Managerial Perspective on Analytics ,"Turban Sharda Delen King.Third Edition
- IBM Student Exercise Guide on Business Intelligence, BA05SG01 V2.0
- Business Intelligence and Analytics Systems for Decision Support 10th Edition Sharda

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate IBM Cognos Report Studio.
- CO2: Implement the operations like import data in Framework , manipulation on Logical Modeling.
- CO3: Understand the use of Dashboard.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1,PO4,PO5/PSO2
CO2	PO5,PO3/PSO4
CO3	PO1,PO11/ PSO3

BCSE0556: HADOOP AND BIG DATA ANALYTICS

Objective: *Exposure to any object oriented programming language (such as Java) and basic operational knowledge of any RDBMS (such as MySQL)*

Credits: 03 L-T–P-J: 3–0–0-0

Module No.	Content	Teaching Hours
I	**Big Data technology Landscape**: Big data growth story, big data sources, Types of Digital Data (Structured, Semi-Structured, Unstructured),Concept, importance and characteristics of data, Challenges with big data, Big data stack, Big Data 1.0, 2.0 and 3.0, Traditional BI vs. Big Data Environment, Big data Process, NoSQL Databases, NoSQL Vs. RDBMS, New SQL, Introduction to Data Science/Scientist **HADOOP 1.0:** Introducing Hadoop 1.0, Limitations of RDBMS, Hadoop Components, High Level Architecture of Hadoop , History of Hadoop, Special Features of Hadoop, Introduction to HDFS 1.0, Architecture, Daemons, Working with HDFS Command, Introduction to Map-Reduce 1.0, Architecture, Daemons **HADOOP 2.0:** Introducing Hadoop 2.0, Limitations of 1.0, Introduction to HDFS 2.0, Architecture, Daemons, Introduction to Map-Reduce 2.0, YARN, Architecture, Daemons, Word Count Example using Java, Introduction to Hadoop 3.0, Difference among Hadoop1.0, Hadoop2.0, Hadoop3.0 **Apache Spark:** Introduction, Introduction to Scala & functional programming, Spark Concepts: Main Primitives, RDD Fault Tolerance, Spark Operations, Job Execution, Spark Built-in libraries **Spark Streaming:** Real-time big data processing with Spark Streaming, the working of Spark Streaming and applications of Spark Streaming, Sliding Window Analytics	13
II	**Introduction to Cassandra DB**: Features of Cassandra, CQL Data Types, CQLSH: CRUD, Counter, TTL, List, Set, Map, Tracing, Import Export csv files **Introduction to HBase:** What is HBase? HBase Architecture, HBase Components, Data model, HBase Storage Hierarchy, Cross-Datacenter Replication, Auto Sharding and Distribution, Bloom Filter and Fold, Store, and Shift **HADOOP Ecosystem and Flume:** Introduction to Hadoop Ecosystem, Sqoop, Zookeeper, Kafka **Introduction to HIVE:** Hive Architecture, Hive Data types, Hive Collection Types, Hive File Formats, Hive Query Language, Hive Partitions, Bucketing, Views, RCFile Implementation, Hive User Defined Function, SerDe, UDF **Introduction to Pig:** History and Anatomy of Pig, Pig on Hadoop, Use Case for Pig, Pig Primitive Data Types, Pig Latin Overview, Execution Modes of Pig, Field, Tuple, Bag, User Defined Function, Parameters in Pig, Piggy Bank, Word count example using Pig, Pig vs Hive, When to use Pig.	14

Text Book:

- IBM Technologies ICE “Big Data Analytics Student Guide”
- Seema Acharya and Subhashini Chellappan, “Big Data and Analytics”, 1st Edition, 2015, Wiley, India.
- Jure Leskovec, Anand Rajaraman, Jeff Ullman, “Mining of Massive Datasets”, 2nd Edition, 2014, Cambridge University Press.

Reference Books:

- Chuck Lam, “Hadoop in Action”, 2nd Edition , Manning Publications, 2014.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Understand the concept and challenges of big data
- CO2: Apply the existing technology to collect, manage, store, query, and analyze the big data.
- CO3: Implement job scheduling and resource management of the cluster using Hadoop and Yarn.
- CO4: Apply data summarization, query, and analysis over the big data with the help of pig and hive.
- CO5: Design the regression model, cluster and decision tree over the real big data.
- CO6: Implement different real life applications by using large-scale analytics tools.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO3/PSO4
CO3	PO2,PO3,PO11/PSO2,PSO4
CO4	PO5,PO2/PSO4
CO5	PO2,PO3/PSO2
CO6	PO3/PSO1

BCSE0585: HADOOP & BIG DATA ANALYTICS LAB

Objective: *This course introduces students to R, a widely used statistical programming language. Students will learn to manipulate data objects, produce graphics, analyse data using common statistical methods, and generate reproducible statistical reports. Student will also learn data mangling.*

Credits: 01 L-T–P-J: 0–0–2-0

Module No.	Content	Lab Hours
I&II	**Module 1: Introduction to R** • Introduction and installation of R and RStudio • Data types, vectors, multidimensional array. • R utilities function • Correlation and Linear Regression • Logistics Regression **Module 2: Hands-On MongoDB, Cassandra** • Installation of VM-Ware and Cloudera • Hands-On Mongo DB: CRUD, Where, Aggregation • Hands-On Mongo DB: Projection, Aggregation • Hands-On Cassandra DB: CRUD, Projection **Module 3: Hands-On MapReduce** • HDFS and its commands • Word-Count program using Map Reduce • Hands-On HIVE and Pig	24

Reference Books:

- Paul Teetor. R Cookbook: Proven recipes for data analysis, statistics, and graphics. O'Reilly Media, Inc.,2011.
- Norman Matloff. Theart of R programming: A tour of statistical software design. No Starch Press, 2011.
- Winston Chang. R graphics cookbook. O'Reilly Media, Inc., 2012.
- Hadley Wickham and Garrett Grolemund. R for data science. 2016.
- Phil Spector. Data manipulation with R. Springer Science& Business Media,,2008.

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

Use R-Studio, read R documentation, and write R scripts.

- Import, export and manipulate data.
- Analyse the data using data analytics latest tools based on HDFS like Pig, Hive
- Implement the aggregation projection on data set using Cassandra, MongoDB.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO5/PSO2

CO2	PO2, PO4/ PSO2
CO3	PO2, PO5/PSO3
CO4	PO3, PO5/PSO4

BCSE0557: SOCIAL WEB AND MOBILE ANALYTICS

Objective: *The course objectives are to give the knowledge of Web & Social media, the need of using Social Media Web Analytics, Dashboard, Relationships, Sentiments, Evolving topics and Reports.*

Credits: 03 **Semester VII** **L–T–P-J: 3–0–2-0**

Module No.	Content	Hours
I	**Introduction to Web & Social Analytics**: What is Social media? Need of using analytics, Social analytics vs web analytics, Types of web analytics, Current analytics platforms, Open source vs licensed platforms, Google analytics, IBM social media analytics, Choosing right specifications and optimal solution. **Relevant Data & its Collection:** Data collection strategy, participating with people centric approach, Social graph, Choosing focused data sources and social networks, Facebook social APIs, Live recruiting and remote user research, Types of surveys. **Welcome to: KPIs/ Metrics:** KPI's, Metrics vs KPI's, Creating KPI's, Basic KPI's, Standard vs critical web metrics, KPI's goals and targets, Specific KPIs, Visualizing the social analytics framework, Build scorecards & dashboards to track KPIs, measuring macro & micro conversions, Measuring success for non-ecommerce and B2B websites. **Manage Web & Social Media with Analytics**: Explore & Evaluate – dashboard, Types of charts, Sharing insights with dashboards, Sentiments, Evolving topics, Segmentation, Discovery, Social media content creation process, Competitive intelligence analysis, Website traffic analysis, Social signals. **Future of Social Media Analytics and Monitoring:** Tasks of social media analytics and monitoring, Mashups, integrating customer profile data, colliding data sets for big bang ideas, Social interactions and web visits, Benefits of social media integration.	20
II	**Introduction to Mobile Analytics:** Global Internet usage, Analyzing the mobile consumer behaviors, Web analytics Vs mobile analytics, Social media analysis can't tell…, Need of mobile analytics, Mobile communication, WAP- wireless application protocol, GGSN, Layered architecture of mobile computing, Mobile cloud computing architecture. **Mobile Customer Experience Management:** Customers end-to-end journey, Customer engagement with mobile apps, Mobile app analytics strategies, Metrics for behavior analysis, Real-time In-app analytics, Voice XML (VXML), Mobile IM and messaging apps, Multichannel campaign optimization, LBS applications for the consumer market. **Mobile analytics for content Publishers & Operators**: Mobile Handset Analysis, Screen resolutions in terms of page views, visits and visitors, Mobile operator analysis, Sessions, Content categorization, Mobile operator - RDSN lookup, Full referral URL report, Search term performance, Specific visitor behavior. **Mobile Analytics in Email Marketing:** The need of mobile email marketing, Features of email marketing tools, Categories of email marketing reports, Email bounce tracking, Unsubscribe reporting, Individual-level email tracking, Cold calling. **Data Functionalities:** Data functionalities, Mobile web page tagging, Aggregate containers, Pageviews per annum, Usability analytics, Form field analytics, Attention map, Data archiving, Historical trends, IBM end to end mobile analytical solution with tealeaf integration, Target page HTTPS communication.	20

Reference Books:

- IBM Student Guide on "SOCIAL WEB AND MOBILE ANALYTICS"

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: By the end of the class, students will learn to:

- CO1: Understand the concepts of Web & Social media, the need of using Social Media Analytics and Web Analytics.

- CO2: Analyze the different analytics platforms and choose the right specifications & optimal solution.
- CO3: Understand the different techniques of collecting and understanding social media data.
- CO4: Understand the concepts of Dashboard, Relationships, Sentiments, evolving topics, Reports and Mashing up Data from Disparate Sources.
- CO5: Understand the importance and need of mobile analytics
- CO6: Understand data functionalities of mobile analytics

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO1, PO4/ PSO1
CO2	PO2, PO5/PSO3
CO3	PO1,PO5/PSO1
CO4	PO3,PO5/PSO1,PSO2
CO5	PO1,PO2/PSO1
CO6	PO1/PSO1,PSO3

BCSE0586: SOCIAL WEB AND MOBILE ANALYTICS LAB

Objective: *This course introduces students to R, a widely used statistical programming language. Students will learn to manipulate data objects, produce graphics, analyze data using common statistical methods, and perform sentiment analysis.*

Credits: 01 **Semester VII** **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I	• Extracting Google Analytics data in R using RGoogle Analytics 1. Installing packages R Google Analytics and their dependent packages. 2. Obtain the credentials with the Google Analytics API. 3. Authenticate the Google Analytics data with the R script and access the Google Analytics data. 4. Obtain the Profile ID/View ID of the Google Analytics profile for which the data extraction has to be done. 5. Generate the query and hit it to the Google Analytics API • Twitter mining for the popular coffee brand "Starbucks". 1. Installing packages twitteR and their dependent packages 2. Obtain the credentials for Twitter with the twitter account 3. Setting the certification at Twitter 4. Searching Twitter and performing sentiment analysis for the tweet named Starbucks. 5. Doing some plots of the obtained results	

Reference Books:

- IBM Guide on Social Web and Mobile Analytics

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: By the end of the class, students learn to:

- CO1: Apply the RStudio to read R documentation, and write R scripts.
- CO2: Implement the code to extract Google analytics data in R.
- CO3: Implement the code to do Twitter mining and perform Sentiment Analysis for the twitter data in R.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/PSOs
CO1	PO5/PSO2
CO2	PO3,PO5/ PSO4
CO3	PO2,PO3,PO4/PSO4

ऋते ज्ञानान्न मुक्तिः

GLA University, Mathura (U.P.)

Institute of Engineering and Technology

Department of Computer Engineering & Applications (CEA)

Course: MCA

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Program Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals or entrepreneurs, for developing sustainable solutions.
PEO2: Attain positions of leadership in an organization and /or on teams.
PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Program Specific Outcomes (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.
PSO2: Design and develop application interfaces along with latest tools and technology to meet the needs of industry.
PSO3: Analyze the algorithmic principles, theory of computation for the modeling and design of computing systems.
PSO4: Apply knowledge to provide solutions to existing problems.

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Program Outcomes (POs)

PO1: Computational Knowledge: Apply knowledge of computing fundamentals, computing specialisation, mathematics, anddomain knowledge appropriate for the computing specialisation to the abstraction andconceptualisation of computing models from defined problems and requirements.

PO2: Problem Analysis: Identify, formulate, research literature, and solve complex computing problems reachingsubstantiated conclusions using fundamental principles of mathematics, computing sciences,and relevant domain disciplines.

PO3: Design /Development of Solutions: Design and evaluate solutions for complex computing problems, and design and evaluatesystems, components, or processes that meet specified needs with appropriate considerationfor public health and safety, cultural, societal, and environmental considerations.

PO4: Conduct Investigations of Complex Computing Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

PO6: Professional Ethics: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.

PO7: Life-long Learning: Recognise the need, and have the ability, to engage in independent learning for continual development as a computing professional.

PO8: Project management and finance: Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO9: Communication Efficacy: Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clearinstructions.

PO10: Societal and Environmental Concern: Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.

PO11: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

PO12: Innovation and Entrepreneurship: Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

Contribution ***1: Reasonable*** ***2:Significant*** ***3: Strong***

Mapping of Programme Educational Objectives with Programme Outcomes

A broad relation between the Programme Objective and the outcomes is given in the following table:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
PEO1	3	3	2	1	3	2	2	1	2	1	2	2
PEO2	2	2	3	1	1	3	3	3	3	3	3	2
PEO3	2	3	2	2	3	2	3	1	2	2	1	3

Mapping of Program Specific Objectives with Programme Outcomes

A broad relation between the Program Specific Objectives and the outcomes is given in the following table:

PROGRAM SPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
PSO1	3	3	3	3	3	2	1	2	2	2	1	2
PSO2	3	3	3	2	3	2	1	2	1	1	2	2
PSO3	3	3	3	3	2	2	2	2	1	1	1	2
PSO4	2	2	3	1	1	2	1	3	2	1	1	3

COURSE STRUCTURE

Master in Computer Applications (MCA)
[Two Years Programme]

Under

Choice Based Credit System (CBCS)

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	MCAC0003	Computer Organization	3	0	0	0	3	3	
2.	MCAC0007	Object Oriented Programming	3	0	0	0	3	3	Computer Programming
3.	MCAC0008	Data Structures	3	1	0	0	4	4	
4.	MCAC0009	Database Management System	3	0	0	0	3	3	
5.	MCAC0010	Operating Systems	3	0	0	0	3	3	
6.	MCAC0011	Computer Networks	3	1	0	0	4	4	
7.	MCAC0012	Software Engineering	3	0	0	0	3	3	
8	MCAC0013	Design and Analysis of Algorithm	3	1	0	0	4	4	
9.	MCAC0014	Web Technology	3	0	0	0	3	3	Object Oriented Programming
10.	MCAC0016	Programming in Python	3	0	0	0	3	3	
PRACTICALS									
10.	MCAC0802	Computer Organization Lab	0	0	2	0	1	2	
11.	MCAC0805	Object Oriented Programming Lab	0	0	4	0	2	4	
12.	MCAC0806	Data Structures Lab	0	0	4	0	2	4	
13.	MCAC0807	Database Management System Lab	0	0	2	0	1	2	
14.	MCAC0809	Web Technology Lab	0	0	4	0	2	4	
15.	MCAC0810	Programming in Python Lab	0	0	4	0	2	4	
		Total	**30**	**3**	**20**	**0**	**43**	**53**	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet : Computer Network & Security									
THEORY									
1.	MCAE0001	Principles of Mobile Computing	3	0	0	0	3	3	Computer Networks
2.	MCAE0002	Ad Hoc Networks	3	0	0	0	3	3	Computer Networks
3.	MCAE0003	Cryptography & Network Security	3	0	0	0	3	3	
4.	MCAE0004	Cybersecurity and Digital Forensics	3	0	0	0	3	3	Computer Networks

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet :Software Engineering									
THEORY									
1.	MCAE0101	Agile Software Development	3	0	0	0	3	3	Software Engineering
2.	MCAE0102	Software Project Management	3	0	0	0	3	3	Software Engineering
3.	MCAE0103	Service Oriented Architecture	3	0	0	0	3	3	Software Engineering
4.	MCAE0104	Management Information System	3	0	0	0	3	3	Software Engineering
5.	MCAE0105	E-Commerce	3	0	0	0	3	3	

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet : Image Processing and Intelligent System									
THEORY									
1.	MCAE0201	Digital Image Processing	3	0	0	0	3	3	Mathematics, Programming
2.	MCAE0202	Introduction to Machine Learning	3	0	0	0	3	3	Mathematics
3.	MCAE0203	Soft Computing	3	0	0	0	3	3	Discrete Mathematics
4.	MCAE0204	Artificial Intelligence	3	0	0	0	3	3	Data Structures
PRACTICALS									
1.	MCAE0271	Digital Image Processing Lab	0	0	2	0	1	2	Programming
2.	MCAE0272	Machine Learning Lab	0	0	2	0	1	2	

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet :Advanced Data Processing									
THEORY									
1.	MCAE0301	Data Mining and Warehousing	3	0	0	0	3	3	DBMS
2.	MCAE0302	Business Intelligence	3	0	0	0	3	3	DMW
3.	MCAE0303	Information Retrieval System	3	0	0	0	3	3	Data Structure
4.	MCAE0304	Big Data and Analytics	3	0	0	0	3	3	DBMS
5.	MCAE0305	Internet of Things	3	0	0	0	3	3	Microprocessors
6.	MCAE0306	Cloud Computing	3	0	0	0	3	3	Distributed System
PRACTICALS									
1.	MCAE0370	Big Data and Analytics Lab	0	0	2	0	1	2	
2.	MCAE0371	Internet of Things Lab	0	0	2	0	1	2	
3.	MCAE0372	Cloud Computing Lab	0	0	2	0	1	2	

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet : Advance Technologies									
THEORY									
1.	MCAE0402	.Net Framework using C#	3	0	0	0	3	3	
2.	MCAE0403	Mobile Application Development	3	0	0	0	3	3	
3.	MCAE0404	Digital Marketing and Transformation	3	0	0	0	3	3	
4.	MCAE0405	Object Oriented Programming Using C++	3	0	0	0	3	3	
PRACTICALS									
1.	MCAE0471	.Net Framework Lab	0	0	4	0	2	4	
2	MCAE0472	Mobile Application Development Lab	0	0	2	0	1	2	
3.	MCAE0473	Object Oriented Programming Lab	0	0	4	0	2	4	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
1.	MCAJ0950	Mini Project-I	0	0	0	2	2	-	
2.	MCAJ0951	Mini Project-II	0	0	0	2	2	-	
3.	MCAJ0971	Major Project	0	0	0	25	25	-	
		Total	**0**	**0**	**0**	**29**	**29**	**-**	

Program Core of Humanities and Social Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0003	English for Professional Purpose–I	2	0	0	0	2	4	
2.	BELH0004	English for Professional Purpose–II	2	0	0	0	2	4	
3.	MELH0007	Ethics & Values	2	0	0	0	2	2	
4.	MBAC0004	Accounting & Financial Management	2	1	0	0	3	3	
5.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
6.	MTDH0301	Soft Skills-I	0	0	2	0	1	2	
7.	MTDH0302	Soft Skills-II	0	0	4	0	1	2	
		Total	**10**	**1**	**6**	**0**	**13**	**19**	

Note:

1. Student must obtain at least **104 credits** in two years for completion of MCA degree.

MCAC0003: COMPUTER ORGANIZATION

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic organization of the computer and block level description of the functional units, Number representation; fixed and floating-point number representation, IEEE standard for floating point representation., Instruction set, Instruction cycles. Register, bus and memory transfer. **Central Processing Unit**: Addition and subtraction of signed numbers, carry look ahead adders. Multiplication: Signed operand multiplication, Booths algorithm and array multiplier. Processor organization, general registers organization, stack organization and addressing modes. Introduction to Combinational Circuit, Multiplexer, demultiplexer, Decoder, Encoder. Introduction to Sequential Circuit, Flip-Flops, Synchronous and Asynchronous Counters **Multiprogramming and Multiprocessing**; Introduction to pipelined operation.	18
II	**Control Unit:** Instruction types, formats, micro-operations, execution of a complete instruction. Hardwired and micro programmed control: micro programmed sequencing, Microinstruction with next address field, pre-fetching microinstructions, concept of horizontal and vertical microprogramming. **Memory:** Basic concept and hierarchy, RAM memories, ROM memories. Cache memories: concept and design issues, performance, address mapping and replacement. Virtual memory: concept and implementation. **Input/Output**: Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Buses, bus architecture, types of buses and bus arbitration. Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access., I/O channels and processors. Standard communication interfaces.	18

Text Books:

- M. Mano , “Computer System Architecture”, 3rd Edition, PHI,l1996

Reference Books:

- D.W. Patterson , “Computer Organization and Design”, 4th**Edition**, Elsevier Publication, 2008.
- William Stalling , “Computer Organization”,8th Edition, PHI, 2011.
- V. CarlHamacher, Zaky , “Computer Organization”,4th International Edition, TMH, 1996.
- John P Hays, “Computer Organization”, 2nd Edition, TMH.
- Tannenbaum , “Structured Computer Organization”, 5thEdition, PHI, 2005.
- P Pal Chaudhry , “Computer Organization & Design”, 2ndEdition, PHI, 2002.

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the basics of digital computer system.
- CO2: Demonstrate the principle of arithmetic operations on unsigned, signed integers and floating point numbers.
- CO3: Understand the concepts of Combinational and Sequential circuits and their applications.
- CO4: Understand the CPU architecture and organization.
- CO5: Explain the basic concepts of pipelining.

- CO6: Design the steps for the execution of the complete instruction for hardwired and micro-programmed control unit.
- CO7: Explain the function of memory hierarchy.
- CO8: Determine the interface of CPU with input/output devices and their modes of transfer.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO1,PO3/PSO1
CO3	PO2,PO3,PO5/PSO2
CO4	PO2,PO3,PO4/PSO1,PSO3
CO5	PO2,PO3,PO4/PSO2
CO6	PO1,PO2,PO3/PSO1,PSO3
CO7	PO2,PO3,PO5/PSO2,PSO3
CO8	PO3,PO4/PSO1

MCAC0007: OBJECT ORIENTED PROGRAMMING

Objective: *The objective of the course is to understand the fundamentals the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**OO Fundamentals:** Need of OO approach, OO Concepts. Characteristics of Object oriented programming. **Basics of Java:** Features of Java, Byte Code and Java Virtual Machine, JDK, Data types, Operator, Control Statements. **Array and String:** Single and Multidimensional Array, String class, Operations on string, Command line argument, Use of Wrapper Class. Classes, Objects and Methods: Class, Object, Constructor, new operator, Constructor Overloading, Method Overloading, Recursion, Passing and Returning object form Method, this and static keyword (variable, method, class and package), Access control, modifiers, Nested class, Inner class, Abstract class, Java Standard Libraries. **Polymorphism:** Method overloading. **Inheritance and Interfaces:** Use of Inheritance, Inheriting Data members and Methods, constructor in inheritance, Types of Inheritance, super keyword, Final keyword, Creation and Implementation of an interface, Dynamic method dispatch, Comparison between Abstract Class and interface.	18
II	**Multithreaded Programming:** Use of Multithread programming, Thread State Diagram, Thread class methods, Runnable interface, Thread priority. **Exception Handling:** Exception and Error, Built in Exception, Use of try, catch, throw, throws and finally, Custom exception. **GUI Programming:** Java Applet, Applet life cycle, Applet Vs Application, Graphics methods, Layout- Flow, Grid, Border, Introduction to AWT Programming, Introduction to Swing, AWT Vs Swing, GUI development in AWT, Swings, Event Delegation Model, Event Handling using Button. **JDBC:** Database Connectivity Model, Types and Roles of Drivers, Database Connectivity Statements, Communicating with Database.	18

Text Book:

- Herbert Schildt , "The Complete Reference, Java Eleventh Edition", Oracle Press, 2019.

Reference Book:

- Cay S Hosrtmann , "Core Java Volume I—Fundamentals, Eleventh Edition", Pearson, 2018.
- Rogers Cadenhead , "Sams Teach Yourself Java in 21 Days (Covers Java 11/12), 8th Edition", Pearson, 2020.

Focus: This course focuses on Employability under CO1, CO3 & CO4.

Outcome: After completion of course, student will be able to:

- CO1: Understand differences between procedures oriented and object-oriented approach.
- CO2: Understand the relevance of Object-Oriented Programming techniques.
- CO3: Understand how to write, compile and execute a Java Program.
- CO4: Understand the use of polymorphism and Inheritance.
- CO5: Understand how to define user exceptions and its uses.
- CO6: Understand what is a thread and Multithreading model.
- CO7: Understand how to develop a GUI application.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1 /PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/ PSO2
CO7	PO1,PO2,PO11/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO2

MCAC0008: DATA STRUCTURES

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs*.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	Introduction to Data Structure, Types, Data Structure Operations, Algorithm Complexity and Time-Space trade-off. **Array:** Representation of Single and Multidimensional Arrays, Address Calculation, Operations on Arrays, and Application of Arrays: Matrix Multiplication, Sparse Polynomial Representation and Addition, Character String Operation. **Stacks:**Array Representation and Implementation of Stack, Operations on Stacks: Push & Pop. **Queues:**Array Representation and Implementation of Queues, Operations on Queue- Create, Add, Delete, Full and Empty, Types of Queues: Circular Queue, D-Queue and Priority Queue. **Application of Stack:** Conversion of Infix to Prefix and Postfix Expressions, Evaluation of Postfix Expression using Stack. **Recursion:**Recursive Definition and Processes, Recursion in C. **Linked Lists:** Representation and Implementation of Singly Linked Lists, Operations on Linked Lists - Insertion and Deletion to/from Linked Lists, Linked Stacks and Queues, Overflow and Underflow Conditions, Polynomial Representation and Addition and Multiplication of Polynomials, Doubly Linked List, Circular linked list.	19
II	**Trees:**Introduction, Binary Trees and their Representation, Algebraic Expressions, Complete Binary Tree. Extended Binary Trees, Array and Linked Representation of Binary Trees, Traversing Binary Trees, Path Length, Huffman Algorithm. **Binary Search Trees**: Binary Search Tree (BST), Insertion and Deletion in BST. **Types of Tress:** Threaded Binary trees, AVL Trees, Introduction to Multi-way Search trees, B-tree. **Searching and Hashing**: Sequential Search, Binary Search, Comparison and Analysis, Hashing Functions, Hash Tables and Collision Resolution Techniques. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Radix Sort, Shell Sort. **Graphs:** Terminologies and Representation, Path Matrix, Graph Traversals - DFS and BFS, Shortest Path Problems, Minimum Cost Spanning Trees, Topological Sort.	19

Text Book:

- Aaron M. Tanenbaum, YedidyahLangsam and Moshe J. Augenstein , "Data Structures Using C and C++", 2nd Edition, PHI, 2009.

Reference Books:

- Horowitz and Sahani , "Fundamentals of Data Structures", 3rd Edition, W H Freeman & Co, 2004-05.
- Jean Paul Trembley and Paul G. Sorenson , "An Introduction to Data Structures with Applications", 2nd Edition, TMH, 2007.
- R. Kruse, "Data Structures and Program Design in C" , 2nd Edition, Pearson Education, 2004.
- LipschutzSchaum's Outline Series , "Data Structures", 12th Reprint, TMH, 2010.
- G A V Pai , "Data Structures and Algorithms", TMH, 2009.

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.
Outcome: After completion of course, student will be able to:

- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2
CO3	PO1/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4/PSO3
CO6	PO2/PSO4
CO7	PO2/PSO4

MCAC0009: DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database system. Students learn how to design and create a good database.*

Credits: 03 **L–T–P-J :3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System Vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with Case Studies. **Data Modeling Using the Entity-Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. **Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization I:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, Non-Redundant Cover, Canonical Cover	19
II	**Database Design & Normalization II:** 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, MVD and JDs, Inclusion Dependence. **File Organization:**Indexing, Structure of Index files and Types, Dense and Sparse Indexing **Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication. .	19

Text Books:

- Elmasri and Navathe , “Fundamentals of Database Systems”, 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler , “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.

References Books:

- Date C J,” An Introduction to Database Systems”, 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , “Database Concepts”, 5th Edition, TMH, 1998.
- Redmond, E. & Wilson, “Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement”, 1st Edition.

Focus: This course focuses on Employability under CO1,CO2,CO3 & CO4.

Outcome: After the completion of the course, the student will:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO2: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO3: Create and populate a RDBMS for a real life application, with constraints and keys,using SQL.
- CO4: Selectthe information from a database by formulating complex queries in SQL.

- CO5: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO6: Discuss indexing mechanisms for efficient retrieval of information from a database.
- CO7: Discuss recovery system and be familiar with introduction to web database, distributed databases.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1 /PSO1
CO2	PO2, PO3/ PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3,PO9/ PSO2
CO7	PO1,PO11 /PSO1

MCAC0010: OPERATING SYSTEMS

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuseson basic hardware architectural issues that affect the nature and performance of software.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Operating System and Functions, Classification of Operating Systems- Batch, Interactive, Multiprogramming Time Sharing, Real Time System, Multiprocessor Systems, Multiuser Systems, Multithreaded Systems, Operating System Structure- Layered Structure, Reentrant Kernels, Monolithic and Microkernel Systems, System Components, Operating System Services. **Processes:**Process Concept, Process States, Process Transition Diagram, Process Control Block (PCB), Principle of Concurrency, Producer/Consumer Problem, Inter Process Communication Models and Schemes, Process Generation, Threads and their Management. **CPU Scheduling**: Scheduling Concepts, Schedulers, Performance Criteria, Scheduling Algorithms, Multiprocessor Scheduling. **Process Synchronization**: Mutual Exclusion, Critical Section Problem, Dekker's Solution, Peterson's Solution, Semaphores, Test and Set Operation, Classical Problem in Concurrency- Dining Philosopher Problem, Readers Writers Problem, Sleeping Barber Problem.	20
II	**Deadlock:** System model, Deadlock Characterization, Prevention, Avoidance and Detection, Recovery from Deadlock, Combined Approach. **Memory Management**: Basic Bare Machine, Resident Monitor, Multiprogramming with Fixed Partitions, Multiprogramming with Variable Partitions, Paging, Segmentation, Paged Segmentation, Virtual memory Concepts, Demand Paging, Performance of Demand Paging, Page Replacement Algorithms, Thrashing, Cache Memory Organization, Locality of Reference. **I/O Management and Disk Scheduling**: I/O Devices, I/O Subsystems, I/O Buffering, Disk Storage and Disk Scheduling, RAID. **File System**: File Concept, File Organization and Access Mechanism, File Directories, and File Sharing, File System Implementation Issues, File System Protection and Security.	20

Text Books:

- Silberschatz, Galvin and Gagne , "Operating Systems Concepts",9th Edition, Wiley, 2012.

Reference Books:

- SibsankarHalder and Alex a Aravind ," Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education,2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This course focuses on Employability CO1, CO2, CO3 & CO4.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the classification of operating system environment.
- CO2: Understand the basic of process management.
- CO3: Apply the concept of CPU process scheduling for the given scenarios.
- CO4: Describe and analyze the memory management and its allocation policies.
- CO5: Illustrate theprocess synchronization and concurrency process in operating system.
- CO6: Analyze the occurrence of deadlock in operating system.

- CO7: Understand the concepts of disk scheduling.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO4/PSO1,POS3
CO4	PO3,PO4,PO6/PSO3,PSO4
CO5	PO1,PO4/PSO1,PSO3
CO6	PO1,PO2 /PSO1,PSO3
CO7	PO1,PO2,PO7/PSO1,PSO3

MCAC0011: COMPUTER NETWORKS

Objective: *The objective is to understand fundamental underlying principles of computer networking, details and functionality of layered network architecture.*

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Network Edge -** Internet - ISPs and Internet Backbones,Use of Computer Networks, Type of Networks, Reference Models- The OSI Reference Model, TCP/IP Reference Model. **Physical Layer**: Direction of Data Flow, Types of Connections, Topologies, Transmission Media-Guided and Unguided,Modulation, Multiplexing, Circuit Switching. **Data Link Layer** :Error Detection and Correction ,Parity – LRC,CRC; Hamming code, Flow Control and Error Control, Stop and Wait, Go Back-N ARQ , Selective Repeat ARQ, Sliding Window, LAN - Ethernet IEEE 802.3 - IEEE 802.4 - IEEE 802.5 - IEEE 802.6. **Medium Access Sub Layer**: Static/Dynamic Channel Allocation in LAN's and MAN's, Multiple Access Protocols, ALOHA, Carrier Sense, Collision Free Protocols	19
II	**Transport Layer-**: Duties of Transport Layer, User Datagram Protocol (UDP), Transmission Control Protocol (TCP) – Segment Format, Window Management; Congestion Control, Quality of Services (QOS) – Integrated Services. **Application Layer**: Domain Name Space, SMTP, FTP, HTTP, Telnet, WWW, Security, Cryptography-Substitution and Transposition, Ciphers, Data Encryption Standard (DES), DES Chaining, RSA Algorithm -Public Key Cryptography; Authentication Protocols, Firewall, VPN.	19

Text Books:

- Forouzan B. A. , "Data Communication and Networking", 4th Edition, McGrawHill,2004.

References:

- Kurose, J.F. and Ross K.W. , "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Addison-Wesle,2005.
- A.S. Tanenbaum , "Computer Networks", 2nd Edition, Prentice Hall India,2006.

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the concept of OSI and TCP/IP reference model.
- CO2: Understand the basics of data transmission at physical layer.
- CO3: Understand the channel allocation using ALOHA, CSMA and CSMA/CD.
- CO4: Apply error detection and correction technique to eliminate transmission error.
- CO5: Analyze the fixed and variable length address (IPv4) subneting for the given scenarios.
- CO6: Understand the design issues of the transport layer.
- CO7: Understand the mechanism of protocols at application layer such as FTP, HTTP, Telnet, DNS.
- CO8: Understand IPv6 addressing and differentiate it from IPv4.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO12/PSO1
CO2	PO1/PSO2
CO3	PO1,PO4/PSO1,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO4,PO6/PSO3
CO6	PO2,PO4/PSO1
CO7	PO5,PO12/PSO2
CO8	PO4,PO7/PSO4

MCAC0012: SOFTWARE ENGINEERING

Objective:*Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introductory Concepts**: The evolving role of software – characteristics, components and applications. **Process Models:** Waterfall Model, Prototyping, Incremental, Spiral. **Agile software Development**: Introduction to Agile, Agile software development framework. **Software Requirement Specification**: Requirement Process, SRS Components, Requirement Specifications with Use Cases Diagram. **Software Project Planning:** Project Planning Objectives. **Software Metrics:** Size, Function Point, Staffing, Project Estimation Methods– COCOMO Model. **Function-Oriented Design**: Problem Partitioning, Abstraction, Top Down and Bottom Up Design. **Module-Level Concepts:** Coupling, Cohesion, Design Notation and Specification - Structure Charts; Structured Design Methodology - Data Flow Diagram, Sequence Diagram.	18
II	**OO Analysis and OO Design:** OO Concepts, Introduction to UML Design Patterns: Class Diagram, Activity Diagram, State Chart Diagram. **Coding**: Coding Process, Verification – Code Inspections, Software Metrics. **Testing Fundamentals**: Test Case Design, Black Box Testing Strategies, White Box Testing, Unit Testing, Integration Testing, System Testing. **Introduction to Automation Testing and Testing Tools:**Automated Testing Process, Framework for Automation Testing, Introduction to Automation Testing Tool. **Software Quality:** Models, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model. **Software Maintenance**: Models, Cost of Maintenance, Re-engineering, Reverse Engineering.	19

Text Books:

- R. S. Pressman , “Software Engineering: A Practitioners Approach”, 7thEdition, McGraw Hill, 2010.

ReferenceBooks:

- K. K. Aggarwal and Yogesh Singh , “Software Engineering”, 3rd Edition, New Age International Publishers, 2008.
- Rajib Mall , “Fundamentals of Software Engineering”, 3rd Edition, PHI Publication, 2009.
- R.E Fairley , “Software Engineering”, McGraw Hill, 2004.
- Sommerville , “Software Engineering”, 9th Edition, Pearson Education, 2010.

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of software engineering.
- CO2: Apply software processes tosolve real world problems.
- CO3: Estimate the cost, effort and schedule of software using COCOMO Model.
- CO4: Analyze the software design techniques (structure chart, SDM, sequence diagram).

- CO5: Understand the basic concepts of OO analysis and design.
- CO6: Develop the test cases to validate the software.
- CO7: Understand the basic models of software Quality and maintenance.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7/PSO1
CO2	PO2,PO3/PSO4
CO3	PO2,PO11/PSO3
CO4	PO3,PO10/PSO4
CO5	PO3,PO7/PSO1
CO6	PO5,PO12/PSO2
CO7	PO4,PO9,PO12/PSO1

MCAC0013: DESIGN & ANALYSIS OF ALGORITHM

Objective: *The objective of this course is that students will construct and application of various data structures and concepts including Trees, Recursion & Dynamic programing.*

Credits: 04 **L–T–P-J: 3–1-0-0**

Module No.	Content	Teaching Hours
I	**Algorithms:** Analyzing algorithms, Complexity of Algorithms. **Growth of functions:** Asymptotic Notations, Recurrence Relations and their Solution Methods. **Sorting and Order Statistics:** Counting, Radix, Bucket sort. **Advanced Data Structures:** Augmenting Data Structures; B – trees, Binomial Heaps, Fibonacci Heaps; Data Structure for Disjoint Sets. **Divide and Conquer**: Quick Sort, Merge Sort. **Greedy Method:** Knapsack Problem, Job Sequencing with Deadlines, Activity Selection Problem, Huffman Codes.	18
II	**Dynamic Programming**: Chained Matrix Multiplications, Longest Common Subsequence (LCS), 0/1 Knapsack. **Backtracking:** 8 – Queens Problem, Graph Coloring. **Branch & Bound:** TSP Problem. **Approximation Algorithms:** Vertex & Set Cover Problem **Graph Algorithms:** Minimum Spanning Trees; Depth First Search, Breadth First Search; Maximum Flow. **Single Source Shortest Path Problem:**Dijkstra& Bellman Ford Algorithms. **String Matching:** Naïve, Rabin Karp, Knuth-Morris-Pratt, Automata Matcher. **NP-Completeness:** Basic Concepts, Nondeterministic Algorithms, NP-Completeness, Examples of NP Complete Problems.	19

Text Books:

- Thomas H. Coremen, Charles E. Leiserson and Ronald L. Rivest, Introduction to Algorithms, Third edition, Prentice Hall of India,2008.

Reference Books:

- Gilles Brassard Paul Bratley ," Fundamentals of Algorithms", Prentice Hall,1996.
- Ellis Horowitz, SartajSahni, SanguthevarRajasekaran , "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd,2008.
- Levitin , "An Introduction to Design and Analysis of Algorithms", Pearson,2008.

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of course, student will be able to:

- CO1: Understanding of complexity representation in terms of Big Oh, Theta and Omega notations.
- CO2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms (quick sort and merge sort).
- CO3: Compare and analyze different data structures (RB Tree, B Tree, Binomial Heaps, Fibonacci Heaps).
- CO4: Understand the major graph algorithms (DFS, BFS, Dijkstra's Bellman Ford) and their analyses.
- CO5: Understand the greedy paradigm and able to analyze when an algorithmic design situation calls for it. Synthesize greedy algorithms (Optimal Reliability Allocation, Minimum Spanning Trees, factorial Knapsack) and analyze them.
- CO6: Synthesize dynamic-programming algorithms (0/1 knapsack problem, Resource allocation problem, Warshal's and Floyd's algorithms) and analyze them.
- CO7: Understand the backtracking paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize backtracking algorithms (N Queen Problem, TSP Problem, sum of subsets problem, Graph Coloring) and analyze them.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4,PO12/PSO1,PSO3
CO2	PO1, PO3,PO4,PO5/PSO1,PSO3
CO3	PO1,PO3, PO6/PSO1,PSO3
CO4	PO1,PO2,PO3, /PSO1,PSO3
CO5	PO1,PO2 /PSO1,PSO3
CO6	PO1,PO2,PO3, PO6/PSO1,PSO3
CO7	PO1,,PO4,PO12/PSO1,PSO3
CO8	PO1,PO2,PO3,PO4,PO12/PSO1,PSO2

MCAC0014: WEB TECHNOLOGY

Objective: *To understand various steps in designing a creative and dynamic website.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours)
I	**Introduction to Client Server Architecture**: Components of Client/Server Application, Client Server Models and their Benefits. Server Side Component Architecture, Multitier Architecture, Web Portal Development & Testing. **Implementation:** HTML- List, Table, Frame, Image, Form and Other Tags with their Usage, Formatting using CSS, DHTML; JavaScript, DOM Basics, Statements, Integrating JavaScript with Various Elements of HTML, XHTML. **XML:** Domain Languages, Comparison with HTML, DTD, CSS, XSL, Content Creation — Entities, Attributes, XML Schema, XML Parsing Techniques;	19
II	XML and Data Binding-JAXB, Integrating XML with other Applications, XLINK , XPOINTER. Introduction to AJAX and Applications. **Distributed Object Computing**: ActiveX, COM, & DCOM. **Web Servers & Application Servers:** Web Security, Middleware Standards-CORBA, Enterprise Java Beans and DNA, Web Services and SOA. **Server Side Implementation:** CGI Background, Overview of PERL, Introduction to ASP, Objects, Components, Connecting with Databases. JSP Architecture, Objects, JSP Directive Elements, Variables & Methods, Sharing Session & Application Data, Introduction to PHP –Basics, Array and Functions.	19

Text Book:

- Chris Bates "Web Programming – Building Internet Application", 2nd Edition, Wiley- Dreamtech India Pvt. Ltd, 2007.

Reference Books:

- Holzener, Steven "Inside XM",Techmedia publication.
- Bergstan, Hans "Java Server Pages", O'ReillyPublication, 2004.
- Nicholas C. Zakas "Professional JavaScript for Web Developers", Wiley Publication, 2011.
- Leon Shklar, Rich Rosen "Web Application Architecture: Principles, Protocols and Practices", 2nd Edition Wiley Publication, 2009.
- Burdman, Jessica "Collaborative Web Development", Addison Wesley, 2000.

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome:

- CO1. Implement static and dynamic clientbased web pages constructs using HTML, DHTML, Javascript
- CO2. Demonstrate the concept of AJAX
- CO3. Implement XML based programming constructs
- CO4. Implement various server based programming constructs of ASP, JSP and PHP
- CO5. Create web applications using PHP and AJAX

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO,PO2,PO3, PO5, PO9/PSO1
CO2	PO,PO2,PO3, PO5, PO9/PSO1
CO3	PO,PO2,PO3, PO5, PO9/PSO1
CO4	PO,PO2,PO3, PO5, PO9/PSO3
CO5	PO,PO2,PO3, PO5, PO9,PO11,PO12/PSO3

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MCAC0016: PROGRAMMING IN PYTHON

Objective: *This course introduces the solving of mathematical problems using Python programming using OO concepts and its connectivity with database.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Lab Hours
I	Introduction to Python: Introduction and Basics; Setting up path Python Data Variables & Operators: Data Variables and its types, id() and type() functions, Coding Standards; **Control Structures:** if-else, elif, Nested if, Iteration Control structures, Break, Continue & Pass; **String Manipulation:** Accessing Strings, Basic Operations, String slicesFunction and Methods. **Lists:** Introduction, accessing list, Operations, Working with lists, Function and Methods. **Tuple:**Introduction, accessing tuples, Operations, Working, Functions and Methods. **Dictionaries:** Introduction, accessing values in dictionaries, Working with dictionaries, Properties,Functions. **Functions:** Defining & Calling a function, Passing arguments to functions – Mutable & Immutable Data Types, Different types of arguments, Recursion, Scope of variables;	18
II	**Modules and Packages:** User-defined modules and Standard Library: random, numpy, sys, Math Module, String Module, List Module, Date & Time Module, Regular Expressions: match, search, replace; Introduction to PIP, Installing Packages via PIP **Input-Output:** Printing on screen, reading data from keyboard, Opening and closing file, Reading and writing files, Functions. **Exception Handling:** Exception, Exception Handling, Except clause, Try? finally clause, User Defined Exceptions. Introduction to series and dataframes& Python using Pandas. **Object Oriented Programming:** Creating Classes, Instance Variables & Access Specifiers, Methods & Complete Python Program, Importance of self, __init__ () method, Instance Methods,	18

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.
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Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of Python Programming.
- CO2: Apply the concepts of control structures and string manipulations of python programming.
- CO3: Understand the use of data structures available in PythonList, Tuple and Dictionary.
- CO4: Experiment user-defined functions and access built-in functions.
- CO5: Experiment user-defined modules and access built-in modules- math, random, string, date, time, datetime.
- CO6: Develop the programs using the concept of File Handling.
- CO7: Develop programs based on Exceptional Handling.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO4
CO2	PO4/PSO1
CO3	PO5/PSO4
CO4	PO5,PO7/PSO1
CO5	PO2,PO8/PSO4
CO6	PO3,PO10/PSO2
CO7	PO5,PO9/PSO1

MCAC0802: COMPUTER ORGANIZATION LAB

Objective: *The aim of the lab is to better understand the design of sequential Circuits such as Flip-Flops, Registers, and Counters.*

Credits: 01

L–T–P–J: 0–0–2–0

Module No.	Content	Lab Hours
I	• Introduction of Computer Organization. • To study and implement various AND GATE using universal gates NAND. • To study and implement various AND GATE using universal gates NOR. • To study and implement various NOT GATE using universal gates NOR. • To study the operation of Demultiplexer. • To study the operation of decimal to BCD encoder. • To study the operation of BCD decoder to decimal. • To study the half adder and full adder using NAND and NOR gates. • To study the half subtractor& full subtractor using NAND & XOR gates. • To study the operation of segment decoder. • To study the operation of Flip –Flop(JK,D, T). • To study the BCD counter. • To study the Ring counter and Johnson counter.	24

Focus: This course focuses on Employability under CO1, CO2.

Outcome: After the completion of the course, the student will be able to:

- CO1: Implement the Combinational and Sequential Circuit.
- CO2: Demonstrate the working of counter and shift register.
- CO3: Demonstrate the working of ALU and seven segment displays.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO5/PSO2
CO2	PO3,PO4/PSO2
CO3	PO3,PO5/PSO1,PSO2

MCAC0805: OBJECT ORIENTED PROGRAMMING LAB

Objective: *The objective of this course is that students will study and learn Object Oriented Modeling and programming.*

Credits: 02 **L–T–P–J: 0–0–4–0**

Module No.	Content	Lab Hours
I	• Programs based on the concepts of: Java Classes, Constructors, Polymorphism and Keyword Static. • Programs based on the concepts of: Inheritance Using Java, Multithreading Using Thread Class &Interface Runnable, String Handling, Generic Classes and Collection API. • Programs based on the concepts of: ○ Applet Programming, Combining Multithreading with Graphics, ○ UI Development Using AWT and Swings, Handling Events on UI Components. • Handling Database Connectivity with Java. • Concepts of Image Processing Using Java. • Implementation of Distributed Computing using RMI.	24

Reference Books:

- Naughton, Schildt, "The Complete Reference JAVA2", 9th Edition, Oracle Press.
- Bhave&Patekar, "Programming with Java", Pearson Education
- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus : This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of course, the student will be able to:

- CO1: Implement object oriented language features.
- CO2: Design GUIs and Graphical programming.
- CO3: Design object oriented solutions for small systems involving database and event handling concepts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO5/PSO2
CO3	PO3,PO5/PSO4

MCAC0806: DATA STRUCTURES LAB

Objective:*The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits: 02

L–T–P-J: 0–0–4–0

Module No.	Content	Lab Hours
I	• Write a program to insert the element at given position in an array and display that array. • Write a program to delete the element from given position in an array and display that array. • Write a program to demonstrate various operations (length, copy, append, compare) on strings. • Write a program to demonstrate various operations (reverse, extracting a substring from left, extracting a substring from right, extracting a substring from middle) on strings. • Write a program to demonstrate various operations (create, push, pop , overflow, underflow, peek , display) of STACK using array implementation. • Write a program to demonstrate various operations (create, enqueue, dequeue, overflow, underflow, peek, display) of QUEUE using array implementation. • Write a program to demonstrate various operations (create, enqueue, dequeue, overflow, underflow, peek, display) of CIRCULAR QUEUE using array implementation. • Write a program to solve the problem of Tower of Hanoi by using recursion. • Write a program to demonstrate various operations (create, Traversing, searching, inserting an element at beginning, at end, after a given element, deleting an element from beginning, from end, after a given element) of a linked list. • Write a program to demonstrate various operations (create, Traversing, searching, inserting an element at beginning, at end, after a given element, deleting an element from beginning, from end, after a given element) of a doubly linked list. • Write a program to demonstrate various operations (create, push, pop , overflow, underflow, peek , display) of STACK using linked list. • Write a program to demonstrate various operations (create, enqueue, dequeue, overflow, underflow, peek, display) of QUEUE using linked list. • Write a program for addition of polynomials. • Write a program to demonstrate various operations (create, insert a new node, search, find smallest element, find largest element, height, number of elements, number of internal nodes, number of external nodes, delete a node) on binary search tree. • Write a program for Preorder Traversal, In-order Traversal and Post-order traversal of a BST. • Write a program for Linear search. • Write a program for Binary search. • Write a program for Bubble sort. • Write a program for Merge sort. • Write a program for Insertion sort. • Write a program for Selection sort. • Write a program for Quick sort. • Write a program to illustrate traversal of a graph using Breadth- first search. • Write a program to illustrate traversal of a graph using Depth- first search. • Write a program for Minimum Spanning Tree. • Write a program to find shortest path for given source and destination.	48

	• Write a program to find shortest path among all pair of vertices.	

Focus: This course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

MCAC0807: DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL.*

Credits: 01 **L–T–P–J :0–0–2–0**

Module No.	Content	Lab Hours
I	• Introduction of Data Definition Language (DDL) and Its commands.(Create, Alter, Drop, Rename). • Introduction of Data Manipulation Language (DML) and Its Commands (Insert, Update, Delete). • Introduction of Transaction Control Language (T.C.L) &Data Control Language(D.C.L.) • Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command. • Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views. • Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date) • To implement concept of Joins in SQL. • To implement the concept of sub-queries. • Introduction to PL/SQL. (i) Programs related to Conditional Statements in PL/SQL (ii) Programs related to Cursors. (iii) Programs related to stored Procedures and Functions (iv) Programs related to Triggers.	24

Focus: This course focuses on Employability under CO1, CO2.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Develop the SQL queries for real life scenarios.
- CO3: Implement the procedural language (PL/SQL) and Triggers.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO2,PO3,PO5/PSO2,PSO3
CO3	PO5/PSO2

MCAC0809: WEB TECHNOLOGY LAB

Objective: *To implement the basic concepts of Object oriented programming and knowledge of Java programming, XML, ASP etc. to develop an interactive web page.*

Credits: 02 **L–T–P–J: 0–0–4–0**

Module No.	Content	Lab Hours
I	**HTML** • Design a profile page consisting of your CV using following HTML elements: Font, Color-Background & Foreground, Margins, Lists, Links, Graphics: Image Scaling, Alignments, Text Wrapping B/W images, Table: Bordering, Image, cell color, cell alignment. • Apply various types of CSS to above experiment. • Design a web form for user registration with some constraints using javascript. • Program based on javascript functions. **XML** • Programs for Internal & External DTD containing student information and displaying it using CSS. • Design XML DTD containing student information using features of Entity and attribute. • Design a program to perform searching based on XML file data. • Design a XML parsing program to read Element value from any XML file using JavaScript. • Design a XML parsing program for data binding and fetching the data in HTML form. • Design a java program to read data from XML file. **ASP, JSP & PHP** • Design a web application in ASP using Request & Response for handling HTML form components. • Design ASP application demonstrating the use of Application object and to display the number of times the page has been visited. • Design ASP application demonstrating database connectivity. • Design a website in JSP/PHP for online purchasing.	**48**

Focus: This course focuses on Employability under CO1, CO2, CO3

Outcome: At the end of the course, students will be able to:

- CO1: Develop web-based application.
- CO2: Write clear and effective Server side & Client side script .
- CO3: Access data using PHP & JSP

***Mapping of Course Outcomes (COs) withProgram Outcomes* (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO3/PSO1
CO2	PO3/PSO2
CO3	PO1/PSO1
CO4	PO5/PSO4

MCAC0810: PROGRAMMING IN PYTHON LAB

Objective: *This course introduces the solving of problems using Python programming using OO concepts and its connectivity with database.*

Credits: 02 **L–T–P–J: 0–0–4–0**

Module No.	Content	Lab Hours
I	Programs based on the concepts of: • Building Python Modules • Obtaining user Data • Printing desired output Programs based on the concepts of: • Conditional if statements • Nested if statements • Using else if and elif Programs based on the concepts of Iteration using different kinds of loops Usage of Data Structures • Strings • Lists • Tuples • Sets • Dictionary Programs related to Object Oriented Concepts: Creating Classes, Instance Variables, Access Specifiers, User defined Methods, Importance of self, __init__() method, Class Methods and Static Methods, Using default parameters in Methods. Handling Database Connectivity with Python: • Inserting and Retrieving Data • Use of Stored Procedures • Invoking stored functions	48

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This course focuses on Employability under CO1, CO2.

Outcome: By the end of the course, students will learn to:

- CO1: Apply OO concepts using Python programming.
- CO2: Apply in-built packages defined in Python.
- CO3: Apply front-end as Python Programming to connect with any back-end.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO4
CO3	PO5/PSO2

MCAJ0950: MINI PROJECT I

Objective: *To implement a computer language to build a software system to reduce the paper work.*

Credits: 01

L–T–P–J :0–0–0–2

Module No.	Content	Lab Hours
I	Students are required to develop a real time application project comprising of minimum 3000 LOC on any platform in a modular structure. The project must be based on any of the subject studied till previous semesters and should have an interactive GUI. The development of the project must consist of the following: Project Planning – Schedule and Activity Estimation using MS Project 2000 SRS in IEEE 830-1998 format Process Framework for development Software Design Document as per IEEE-1016 Interfaces Detail and Component Level Design Test Cases development as per the stated Software requirement, which is further to be tested on any CASE tool. In order to obtain creativity, it is required that, the software must have minimal use of library/ library functions of respective language/ package	

Outcome: *After completing the project, the students should gain an insight into the development process of real projectsand to understand the concepts of software products and software processes.*

MCAJ0951: MINI PROJECT II

Objective: *To implement a computer language to build a software system to reduce the paper work.*

Credits: 01 **L–T–P–J:0–0–0–2**

Module No.	Content	Lab Hours
I	Students are required to develop a real time application project comprising of minimum 3000 LOC on any platform in a modular structure. The project must be based on any of the subject studied till previous semesters and should have a interactive GUI. The development of the project must consist of the following : Project Planning – Schedule and Activity Estimation using MS Project 2000 SRS in IEEE 830-1998 format Process Framework for development Software Design Document as per IEEE-1016 Interfaces Detail and Component Level Design Test Cases development as per the stated Software requirement, which is further to be tested on any CASE tool. In order to obtain creativity, it is required that, the software must have minimal use of library/ library functions of respective language/ package	

Outcome:

After completing the project, the students should gain an insight into the development process of real projectsand to understand the concepts of software products and software processes.

MCAE0001: PRINCIPLES OF MOBILE COMPUTING

Objective:To learn the cellular concepts and to know about the radio wave propagation along with various wireless techniques.

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Issues in Mobile Computing, Overview of Wireless Telephony, Cellular Concept, GSM, Air-Interface, Channel Structure, Location Management: HLR-VLR, Hierarchical, Handoffs, Channel Allocation in Cellular Systems, CDMA, GPRS. **Wireless Networking, Wireless LAN Overview:** MAC Issues, IEEE 802.11, Blue Tooth, Wireless Multiple Access Protocols, TCP Over Wireless, Wireless Applications, Data Broadcasting, Mobile IP.WAP- Architecture, Protocol Stack, Application Environment, Applications. **Data Management:**Data Management Issues, Data Replication for Mobile Computers, Adaptive Clustering for Mobile Wireless Networks, File System, Disconnected Operations,	20
II	Mobile Agents Computing, Security and Fault Tolerance, Transaction Processing in Mobile Computing Environment. **AdhocNetworks**: Localization, MAC Issues, Routing Protocols, Global State Routing (GSR), Destination Sequenced Distance Vector Routing (DSDV), Dynamic Source Routing (DSR), Ad Hoc on Demand Distance Vector Routing (AODV), Temporary Ordered Routing Algorithm (TORA),QoS in Ad Hoc Networks, Applications.	20

Text Books:

- Mobile Communications, 2nd Edition by Jochen Schiller, Pearson Education
- Handbook of Wireless Networks and Mobile Computing Edited by Ivan Stojmenović, John Wiley & Sons, Inc.

Reference Books:

- Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML by Reza B'Far, Cambridge University Press
- Fundamentals of Mobile and Pervasive Computing by Frank Adelstein, Sandeep KS Gupta, Golden Richard III and Loren Schwiebert, McGraw-Hill Professional
- 802.11 Wireless Networks: The Definitive Guide, 2nd Edition by Matthew Gast, O'Reilly Media

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: By the end of the class, students will learn to:

- CO1: Understand the basic concepts of mobile communication.
- CO2: Explain the concepts of mobile radio system and cellular system.
- CO3: Discuss the Free space, reflection and diffraction, propagation model.
- CO4: Explain the different fading models.
- CO5: Understand the different medium access techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7,PO10/PSO1,PSO4
CO2	PO1,PO7,PO10/PSO1,PSO4
CO3	PO1,PO6,PO7/PSO1,PSO4
CO4	PO1,PO4,PO7/PSO1,PSO4
CO5	PO1,PO2,PO6/PSO1,PSO4

MCAE0002: AD HOC NETWORKS

Objective: *This course is offered for those who are interested in understanding and building systems support mechanisms for mobile computing systems including client-server web/database/file systems, and mobile ad hoc and sensor networks for achieving the goal of anytime, anywhere computing in wireless mobile environments.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Ad Hoc Wireless Networks:** Characteristics of MANETS, Applications of MANETS, Challenges. **Routing in MANETS:** Topology based versus position-based approaches, Topology based routing protocols, and position-based routing, other routing protocols. **Data Transmission in MANETS:**The broadcast storm, Multicasting, Geocasting. **TCP Over Ad Hoc Networks:**TCP protocol overview, TCP and MANETS, Solutions for TCP over Ad Hoc networks. **Basics of Wireless Sensors and Applications:** The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications.	20
II	**Data Retrieval in Sensor Networks:**Classification of WSNs, MAC Layer, Routing Layer, High LevelApplication layer Support, Adapting to the Inherent Dynamic Nature of WSNs. **Introduction:** Basic principles and challenges, past and ongoing VANET activities. Cooperative Vehicular Safety Applications Enabling technologies,cooperative system architecture, safety applications. Vehicular Mobility Modeling Random models. MAC Layer of Vehicular Communication Networks Proposed MAC approaches and standards, IEEE 802.11p. **VANET Routing protocols:** Opportunistic packet forwarding, topology-based routing, geographic routingStandards and Regulations Protocol Stack, DSRCregulations and standards.	20

Text Books:

- Ad Hoc and Sensor Networks: Theory and Applications, Carlos de MoraisCordeiro and Dharma PrakashAgrawal, World Scientific Publications / Cambridge University Press,2006.
- Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science Imprint, Morgan Kauffman Publishers, 2005

Reference Books:

- Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy and B. S. Manoj, Pearson Education, 2004.
- Guide to Wireless Sensor Networks, SudipMisra, Isaac Woungang, and Subhas Chandra Misra, SpringerInternational Edition, 2012.
- Wireless Mesh Networking, Thomas Krag and SebastinBuettrich, O'Reilly Publishers,2007.
- Wireless Sensor Networks – Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, 2010.
- Wireless Ad hoc Mobile Wireless Networks-Principles, Protocols and Applications, Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008.
- Wireless Ad hoc Networking, Shih-Lin Wu, Yu-Chee Tseng, Auerbach Publications, 2007
- Wireless Ad hoc and Sensor Networks–Protocols, Performance and Control, JagannathanSarangapani, CRC Press, 2007.

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4,CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the concept of mobile ad hoc networks and their design and implementation issues.
- CO2: Demonstrate the proactive, on-demand, and hybrid routing mechanisms.
- CO3: Explain sensor networks and their characteristics.
- CO4: Understand the mechanism of data retrieval in wireless sensor networks.
- CO5: Understand the characteristics of VANETs.
- CO6: Understand the differences in routing mechanism in MANETs and VANETs

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO4
CO3	PO1,PO5,PO6/PSO1,PSO2
CO4	PO1,PO4/PSO2,PSO4
CO5	PO1,PO2/PSO1,PSO4
CO6	PO1,PO5/PSO2,PSO4

MCAE0003: CRYPTOGRAPHY & NETWORK SECURITY

Objective:*This Course focuseses towards the introduction of network security using various cryptographic algorithms and understanding network security applications and practical applications that have been implemented and are in use to provide email and web security*.

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Cryptography**: Introduction to Security Attacks, Services and Mechanisms, Introduction to Cryptology, Conventional Encryption Model, Classical Encryption Techniques-Substitution Ciphers & Transposition Ciphers, Cryptanalysis, Stereography, Stream & Block Ciphers. **Modern Block Ciphers:** Block Ciphers Principles, DES Principal, Strength of DES, Differential & Linear Cryptanalysis of DES, Block Cipher Model of Operation, Triple DES, AES, BLOWFISH,IDEA Encryption & Decryption, Confidentiality Using Conventional Encryption, Traffic Confidentiality, Key Distribution, Random Number Generation. **Principles of Public Key Cryptography**: Principle of Public Key Cryptography, Prime and Relative Prime Numbers, Modular Arithmetic, RSA Algorithm, Security of RSA Key Management.	20
II	**Message Authentication & Hash Function:** Authentication Recruitments, Authentications Functions, Message Authentication Codes, Digital Signatures, Authentication Protocols Digital Signatures Standard (DSS), Proof of Digital Signatures Algorithm. **Electronics Mail Security**: Pretty Good Privacy (PGP), S/MIME, IP Security-IP Security Overview, Architecture, Authentication Header; Encapsulating Security Payloads Combining Security Association, Key Management. **Web Security:** Socket Layer & Transport Layer Security, Secure Electronic Transaction (SET). **System Security:** Intruders, Viruses and Related Threads, Firewall Design Principles.	20

Text Books:

- W. Stallings , "Cryptography and Network Security: Principles and Practices",5th Edition, Pearson Education,2010.

Reference Books:

- B. A. Forouzan , "Cryptography & Network Security", 3rd Edition, Tata McGraw Hill,2003.
- Wenbo Mao , “Modern Cryptography: Theory and Practice”, Prentice Hall,2003.
- Douglas Stinson, "Cryptography Theory and Practice", 2nd Edition, Chapman& Hall/CRC

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of course, the student will be able to:

- CO1: Understands the basic concepts of cryptography.
- CO2: Apply the symmetric key concepts of DES and AES for securing data.
- CO3: Apply the concepts of number theory of Asymmetric key cryptosystem.
- CO4: Understand the concepts of hash function, MAC and digital signature for data integrity.
- CO5: Explain the symmetric and asymmetric key distribution techniques.
- CO6: Understand the concepts of security mechanism at TCP/IP layer.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5,PO12/PSO2,PSO3
CO2	PO1,PO2,PO3,PO12/PSO1,PSO2
CO3	PO1,PO2,PO4,PO5,PO6/PSO1,PSO4
CO4	PO1,PO2,PO3,PO5,PO6/PSO1,PSO3
CO5	PO1,PO2,PO6,PO12/PSO1,PSO4
CO6	PO1,PO2,PO6,PO12/PSO1,PSO4

MCAE0004: CYBERSECURITY AND DIGITAL FORENSICS

Objective: *To give knowledge of constitutional and case law to search and capture digital evidence, determine the most effective and appropriate forensic response strategies to digital evidence, and provide effective proof in a case involving digital evidence.*

Credits:04 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction and Overview of Cyber Crime - Nature and Scope of Cyber Crime - Types of CyberCrime: Social Engineering - Categories of Cyber Crime - Property Cyber Crime. **Cyber Security issues:** Unauthorized Access to Computers - Computer Intrusions - White collar Crimes - Viruses and Malicious Code -Security Engineering - Network Security,Information Security,Web Security,Database Security,Malware Security,Biometric Security, Security in Cloud Computing and Mobile Computing. Software Piracy - Intellectual Property - Digital laws and legislation - Law Enforcement Roles and Responses. **Investigation** Introduction to Cyber Crime Investigation - Investigation ToolsDiscovery - Digital EvidenceCollection - Evidence Preservation - E-Mail Investigation	20
II	Tracking - IP Tracking - E-MailRecovery - Hands on Case Studies - Encryption and Decryption Methods - Search and Seizure ofComputers - Recovering Deleted Evidences - Password Cracking. **Digital forensics** Introduction to Digital Forensics - Forensic Software and Hardware - Analysis and AdvancedTools - Forensic Technology and Practices - Forensic Ballistics and Photography - Face, Iris and Fingerprint Recognition - Audio Video Analysis - Windows System Forensics - Linux System Forensics - Network Forensics. **Laws and acts** Laws and Ethics - Digital Evidence Controls - Evidence Handling Procedures - Basics of IndianEvidence ACT IPC and CrPC - Electronic Communication Privacy ACT - Legal Policies	19

Text Books:

- Guide to Computer Forensics and Investigations 6th Edition by Bill Nelson, Amelia Phillips and Christopher Steuart, Cengage Publication
- Incident Response & Computer Forensics, Second edition by Chris Prosise and Kevin Mandia, McGraw-Hill Education

Reference Books:

- Computer Forensics and Digital Investigation with EnCase Forensic v7 1st Edition by Suzanne Widup, McGraw-Hill Education
- Forensic Computer Crime Investigation by Thomas A. Johnson, CRC Press
- Software Forensics: Collecting Evidence from the Scene of a Digital Crime 1st Edition by Robert Slade, McGraw-Hill Education

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of cyber security.
- CO2: Explain the basic concepts of System security.
- CO3: Understand the different investigation mechanism of cyber security.
- CO4: Explain the digital forensics in system security.
- CO5: Illustrate the laws and acts in cyber domain.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO6,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO4,PO5/PSO1,PSO4
CO3	PO1,PO3,PO4,PO6/PSO1,PSO3,PSO4
CO4	PO1,PO2,PO5/PSO1,PSO3
CO5	PO1, PO3,PO5/PSO1,PSO3

MCAE0101: AGILE SOFTWARE DEVELOPMENT

Objective: *Awareness of basics of software engineering concepts and waterfall methodologyandexposure to any object oriented programming language such as Java, C# in agile framework*

Credits: 03 **L–T–P–J :3–0–0–0**

Module No.	Content	Teaching Hours
I	**Fundamentals of Agile:** The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools **Agile Scrum Framework:** Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management **Agile Software Design and Development:** Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design.	20
II	**Need and significance of Refactoring-** Refactoring Techniques, Continuous Integration, Automated build tools, Version control. Current researches in Agile software development **Agile Testing:** The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester **Industry Trends:** Market scenario and adoption of Agile, Agile ALM, Roles in an Agile project, Agile applicability, Agile in Distributed teams, Business benefits, Challenges in Agile, Risks and Mitigation, Agile projects on Cloud, Balancing Agility with Discipline, Agile rapid development technologies	20

Text Book:

- Ken Schawber& Mike Beedle, Agile Software Development with Scrum, Pearson, 2008

Reference Books:

- KenSchawber&MikeBeedle, AgileSoftwareDevelopmentwithScrum,Pearson,2008
- RobertC.Martin,AgileSoftwareDevelopment,Principles,PatternsandPractices,Prentice Hall,2002
- LisaCrispin&JanetGregory,AgileTesting:APracticalGuideforTestersandAgileTeams, Addison Wesley,2008
- AlistairCockburn,AgileSoftwareDevelopment:TheCooperativeGame,AddisonWesley,2006

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of the course, students will be able to:

- CO1: UnderstandthesignificanceofAgileMethodologiesinsoftwaredevelopment.
- CO2: Compare and contrast the different agilemethods.
- CO3: Determine the suitability of agile methods for a particularProject.
- CO4: Evaluatehowwellaprojectisfollowingagileprinciples,andassisttheprojecttobecome more agile (whereappropriate).
- CO5: Understandthe relationshipbetweenthecustomerandthedevelopmentteaminagileprojects and the responsibilities of bothcommunities.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3,PO5,PO7,PO10/PSO1,PSO4
CO2	PO2,PO4,PO9/PSO2,PSO4
CO3	PO2,PO6,PO11/PSO1,PSO4
CO4	PO1,PO2,PO4/PSO1,PSO3
CO5	PO8,PO9,PO10,PO11/PSO2

MCAE0102: SOFTWARE PROJECT MANAGEMENT

Objective: *To learn the concepts used to develop a software project and to manage the project.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction And Software Project Planning:** Project Management (PM) Fundamentals, People, Process, Product, Technology, Need Identification, Vision And Scope of Document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning Objectives, Project Plan, Types of Project Plan, Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Team Dynamics, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project Schedule, Scheduling Objectives, Software Project Estimation Models and Methods, Network Diagrams- PERT, CPM; Bar Charts, Milestone Charts, Gantt Charts. **Project Monitoring and Control:** Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators- Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV),Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking.	20
II	**Software Reviews:** Types of Review-Inspections,Deskchecks, Walkthroughs, Code Reviews, Pair Programming. **Risk Management:** Risks and Risk Types, Risk Breakdown Structure (RBS), Risk Management Process: Risk Identification, Risk Analysis, Risk Planning, Risk Monitoring, Cost Benefit Analysis. **Software Project Management Tools:** CASE Tools. **Software Configuration Management:** Software Configuration Items and Tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control Testing Objectives, Testing Principles, Test Plans, Test Cases, Types of Testing, Levels of Testing, Test Strategies, Program Correctness, Program Verification & Validation, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, Quality Management and ISO 9000 Quality Assurance Method, The SEI Capability Maturity Model CMM),SQA Activities, Formal SQA Approaches- Proof of Correctness.	20

Text Book:

- Bob Hughes and Mike Cotterell, Software Project Management, Tata McGraw Hill ,2009.
- Daniel Galin, "Software Quality Assurance: from Theory to Implementation", Addison-Wesley, 2003.

Reference Books:

- Roger Pressman, "A practitioner's Guide to Software Engineering" , Tata McGraw Hill ,2014
- Andrew Stellman; Jennifer Greene, Applied Software Project Management, O'Reilly Media, Inc. 2005.
- Ramesh Gopalaswamy, "Managing and global Software Projects", Tata McGraw Hill Tenth Reprint, 2011.

Focus: This course focuses on Employability and Skill Development under CO1, CO2 ,CO3 &CO4

Outcome: After completion of the course, students will be able to:

- CO1: Understand the basics of software project management.
- CO2: Understand the concept behind the planning, scope and feasibility of a project.
- CO3: Identify the theoretical and methodological issues involved in modern software engineering project management.
- CO4: Analyze various project estimation techniques, especially size estimation (FP), effort estimation (COCOMO models), schedule estimation (GANTT charts), and cost estimation.
- CO5: Understand the concept oftime and cost Management in a projectlife cycle
- CO6: Understand Project Communication Management and Project Risk Management.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1,PSO4
CO3	PO2/PSO3
CO4	PO1,PO2/PSO3
CO5	PO1,PO2/PSO1,PSO4
CO6	PO1/PSO1

MCAE0103: SERVICE ORIENTED ARCHITECTURE

Objective: *The use of fundamental understanding of operating system, distributed system and web technologies in service oriented technologies.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction**: Roots of SOA, Characteristics of SOA, Comparing SOA to Client Server and Distributed Internet Architectures, Anatomy of SOA, How Components in an SOA Interrelate, Principles of Service Orientation, Web Services, Service Descriptions, Messaging with SOAP, Message Exchange Patterns Coordination, Atomic Transactions, BusinessActivities, Orchestration, Choreography, Service Layer Abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer. **Service Oriented Analysis:** Business Centric SOA, Deriving Business Services, Service Modeling, Service Oriented Design, WSDL Basics, SOAP Basics	20
II	**SOA Composition Guidelines** – Entity, Centric Business Service Design, Application Service Design, Task Centric Business Service Design, SOA Platform Basics, SOA Support in J2EE, Java API for XML Based Web Services, (JAX,WS), Java Architecture for XML Binding (JAXB), Java API for XML Registries (JAXR) , Java API for XML Based RPC (JAX,RPC). **Web Services Interoperability Technologies (WSIT):** SOA Support in .NET, Common Language Runtime, ASP.NET Web Forms, ASP.NET Web Services, Web Services Enhancements (WSE), WS, BPEL Basics, WS Coordination Overview, WS Choreography, WS Policy, WS Security.	20

Text Book:

- Thomas Erl , "SOA Principles of Service Design" The Prentice Hall Service Oriented Computing Series, Prentice Hall India,2008.

Reference Books:

- Newcomer, Lomow , "Understanding SOA with Web Services", Pearson Education,2005.
- Sandeep Chatterjee, James Webber , "Developing Enterprise Web Services: An Architect's Guide", Pearson Education,2005.
- Munindar P. Singh, Michael N. Huhns , "Service-Oriented Computing: Semantics, Processes Agents", Wiley,2010.
- Dan Woods and Thomas Mattern , "Enterprise SOA Designing IT for Business Innovation", 1st Edition, O'Reilly,2006.

Focus: This course focuses on Employability under CO1, CO4, CO5.

Outcome: After completion of the course, students will be able to:

- CO1: Understand the concept of service oriented architecture.
- Co2:Compare service oriented architecture with client server, and distributed internet architectures.
- CO3: Understand the concept of service oriented analysis.
- CO4: Understand the SOA Composition and Guidelines.
- CO5: Demonstrate the use of java API for XML based services.
- CO6: Understand the WS Integration concepts.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO3
CO3	PO2/PSO3
CO4	PO3/PSO1
CO5	PO3,PO5/PSO4
CO6	PO4,PO5/PSO4

MCAE0104: MANAGEMENT INFORMATION SYSTEM

Objective: *Explores current Information Systems concepts and technologies. Students learn how information systems give a business or organizations a competitive edge by providing technologies that help managers plan, control, and make decisions.*

L–T–P–J: 3–0–0–0

Credits: 03

Module No.	Content	Teaching Hours
I	**System Concept:** Definition of Systems, Components of System, Types of System, Concept of Data and Information. **Information Systems:** Definition of Information System, Classification of Information System, Operation Support System, Management Support System, Importance of Management Information System. **Management Support System and Classifications:** Management Information System, Decision Support Systems, Executive Information System, Knowledge Management Systems and Expert System. **Role of Management Information System:** Competitive Strategy concept, Value Chain and Strategic IS, Business Process Reengineering, Difference between Business Improvement and BPR Concept of Organizational Planning, The Planning Process.	20
II	**Developing MIS System:**System Development Life Cycle, Traditional Approach and Prototyping Approach, Feasibility Analysis, System Analysis, System Design. **Developing MIS System:**System Implementation, Testing, DocumentationTraining,Conversion & Maintenance. **Applications:**Enterprise Resource Planning, Supply Chain Management, Procurement Management Customer Relationship Management. Security & Ethical Challenges of IT. Ethical Responsibilities –Business Ethics, Technology Ethics.	20

Text Books:

- O'Brien ,"Management Information System. 8th Edition"; Tata McGraw-Hill Publication, 2007.

Reference Books:

- Laudon & Laudon ,"Business Information System". 9th Edition. Tata McGraw-Hill Publication, 2007.
- Jawedkar, S. , "Management Information System". 3rd Edition. Tata McGraw-Hill Publication, 2007.
- David, W. , "Business Data Analysis using Excel". Oxford Publications, 2008.

Focus: This course focuses on Employability under CO1, CO2

Outcome: Upon successful completion of the course, a student will be able to:

- CO1: Understand the critical concepts and terminologies in information systems.
- CO2: Understand the role of IT managers in information systems planning, systems development, and hardware and software selection.
- CO3: Define problems and the current environment for existing business systems in the areas of accounting, finance, marketing, and manufacturing.
- CO4: Know the important business functions provided by typical business software such as Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP).

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO3
CO3	PO2/PSO3
CO4	PO3/PSO1

MCAE0105: E-COMMERCE

Objective: *The objectives of the course are to introduce the concept of electronic commerce, and to understand how electronic commerce is affecting business enterprises, governments, consumers and people in general.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Electronic Commerce - Technology and Prospects, Definition of E- Commerce, Economic Potential of Electronic Commerce, Incentives for Engaging in Electronic Commerce, Forces Behind E-Commerce, Advantages and Disadvantages, Architectural Framework, Impact of E-commerce on Business. **Network Infrastructure for E- Commerce:** Internet and Intranet based E-Commerce, Issues, Problems and Prospects, Network Infrastructure, Network Access Equipments, Broadband Telecommunication (ATM, ISDN, FRAME RELAY). **Mobile Commerce:** Introduction, Wireless Application Protocol, WAP Technology, Mobile Information Device, Mobile Computing Applications.	20
II	**Web Security:** Security Issues on Web, Importance of Firewall, Components of Firewall, Transaction Security, Emerging Client Server, Security Threats, Network Security, Factors to Consider in Firewall Design, Limitation of Firewalls. **Encryption:** Encryption Techniques, Symmetric Encryption- Keys and Data Encryption Standard, Triple Encryption; Asymmetric Encryption- Secret Key Encryption, Public and Private Pair Key Encryption; Digital Signatures, Virtual Private Network. **Electronic Payments:** The SET protocol, Payment Gateway, Certificate, Digital Tokens, Smart Card, Credit Card, Magnetic Strip Card, E-Checks, Credit/Debit Card Based EPS, Online Banking, EDI Application in Business, E- Commerce Law, Forms of Agreement, Govt. Policies and Agenda.	20

Text Book:

- Ravi Kalakota, Andrew Winston, "Frontiers of Electronic Commerce", Addison Wesley,2004.

Reference Books:

- Bajaj and Nag , "E-Commerce the Cutting Edge of Business", TMH,2005.
- P. Loshin, John Vacca, "Electronic Commerce", Firewall Media, New Delhi.

Focus: This course focuses on Employability under CO1, CO2,CO4 &CO7.

Outcome:

- CO1: Explain the components and roles of the Electronic Commerce environment.
- CO2: Explain how businesses sell products and services on the Web.
- CO3: Describe the qualities of an effective Web business presence.
- CO4: Describe E-Commerce payment systems.
- CO5: Explain how to meet the needs of Web site visitors.
- CO6: Identify and reach customers on the Web.
- CO7: Understand Web marketing approaches and elements of branding.
- CO8: Explain the client/server infrastructure that supports electronic commerce.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO3
CO3	PO2/PSO3
CO4	PO3/PSO1
CO5	PO3,PO5/PSO4
CO6	PO4,PO5/PSO4

MCAE0201: DIGITAL IMAGE PROCESSING

Objective: *The objective is to introduce students the Fundamentals of digital Image processing. Students should study the basic of image operations and understand image analysis algorithm. Students can have exposure to current applications in the field of digital image processing*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction and Fundamentals:** Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization, Some Basic Relationships between Pixels, An Introduction to the Color Image Model. **Intensity Transformations and Spatial Filtering:** Introduction, Some Basic Intensity Transformation Functions, Histogram Processing, Histogram Equalization, Histogram Specification, Local Enhancement, Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging, Basics of Spatial Filtering, Smoothing - Mean filter, Ordered Statistic Filter, Sharpening – The Laplacian. **Filtering in the Frequency Domain:** Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters, Selective Filtering.	20
II	**Morphological Image Processing:** Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening. **Image Segmentation:** Introduction, Point, Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection, Cannay Edge Detection, Edge Linking and Boundary Detection (Hough Transform), Thresholding, Region-Based Segmentation. **Representation and Description:** Representation- Boundary (Border) Following, Chain Codes, Polygonal Approximations Using Minimum-Perimeter Polygons, Signatures, Boundary Descriptors, Regional Descriptors.	20

Text Books:

- R.C.Gonzalez and R.E.Woods , “Digital Image Processing”, Prentice Hall, 3rd Edition,2011.

Reference Books:

- BhabatoshChanda and D. DuttaMajumder , “Digital Image Processing and Analysis”, PHI,2011.
- S. Sridhar , “Digital Image Processing”, Oxford University Press,2011.

Focus: This course focuses on Employability under CO1, CO2, CO3

Outcome: After completion of course, student will be able to:

- CO1: Understand mathematical formulation of an image, its processing steps and relationship between image pixels.
- CO2: Apply Image enhancement using intensity transformations and spatial filtering.
- CO3: Analyze image enhancement for frequency domain using Fourier transform.
- CO4: Formulate region of interest through morphological operations.
- CO5: Evaluate strongly co-related regions obtained through Segmentation using discontinuity and homogeneity based segmentation techniques
- CO6: Describe an object of an image using Shape Number and Boundary descriptors.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2,PO3/PSO1,PSO3
CO2	PO3,PO5,PO11,PO12/PSO3,PSO4
CO3	PO1,PO2,PO3,PO7/PSO2,PSO3
CO4	PO1,PO2,PO4/PSO1,PSO2,PSO4
CO5	PO4,PO5,PO3/PSO1,PSO2,PSO3
CO6	PO9,PO10,PO11,PO12/PSO1,PSO2,PSO4

MCAE0203: SOFT COMPUTING

Objective: *Students will get an insight of the intelligent computational approaches.Providing students, the mathematical background to carry out optimization*

Credits: 03 **L–T–P–J : 3–0–0–0**

Module No.	Content	Teaching Hours
I.	**Neural Networks :**Introduction to Soft Computing & Neural Computing, Fundamentals of Artificial Neural Network(ANN), Models of ANN, Architectures of ANN(Feed forward and Feedback or Recurrent N/W), Learning Methods in ANN, Taxonomy of ANN System, Single Layer Perceptron, Linearly Separable Task and XOR Problem, Introduction to Error Back Propagation Network(EBPN), Back Propagation Learning, Error Back Propagation Learning Algorithm, Associative Memory, Auto Associative Memory, Bidirectional Hetro-Associative Memory, Adaptive Resonance Theory, Applications of Neural Network, ADALINE, MADALINE Network, Rosenblatt's Perception. **Fuzzy Logic:** Introduction to Fuzzy Sets & Crisp Sets, Fuzzy Membership and Fuzzy Operations, Properties of Fuzzy sets, Crisp Relations and Fuzzy Relations, Fuzzy System, Crisp Logic, Propositional Logic and its Laws, Inference in Propositional Logic (Modus Ponens, Modus Tollens and Chain Rule), Fuzzy Logic, Inference in Fuzzy Logic(GMP and GMT),	20
II.	Fuzzy Rule Based System, Fuzzyfications&Defuzzificataions, Applications of Fuzzy Logic. **Genetic Algorithm(GA):**Introduction to GA, Search Optimization Method, Evolutionary Algorithm Working Principle, Biological Background of GA, Working Principles of GA, Flow Chart of Genetic Programming, Encoding(Binary, Value, Permutation, Tree), Operators of GA(Random Population, Reproduction or Selection), Crossover and Mutation, Basics of Genetic Algorithm with Example for Maximize f(x)=x2.	19

Text Books:

- S. Rajsekaran& G.A. VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", 4th Edition, Prentice Hall of India,2003.

Reference Books:

- Timothy J Ross ,"Fuzzy Logic with Engineering Applications", 3rd Edition, John Wiley and Sons,2016.
- David E. Goldberg ,"Genetic Algorithm in Search Optimization and Machine Learning "Adission-Wesley,2009.
- Karray , "Soft Computing and Intelligent Systems Design: Theory, Tools and Applications", 1st Edition, Pearson Education,2009.

Focus: This course focuses on Employability under CO1, CO2

Outcome: After completion of course, student will be able to:

- CO1: Understand basics of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
- CO2: Demonstrate the ability to develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.
- CO3: Understand about the fundamental theory and concepts of neural networks, neuro modeling, several neural networks paradigms and its applications.
- CO4: Design and implement the concepts of knowledge using fuzzy inference systems and other machine intelligence applications.

- CO5: Identify an evolutionary computing paradigm known as genetic algorithms and its applications to engineering optimization problems.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PSO3
CO2	PO2,PO3, PO4/PSO2
CO3	PO2,PO3, PO5/PSO4
CO4	PO1,PO12/PSO4
CO5	PO2,PO5,PO12/PSO4

MCAE0204: ARTIFICIAL INTELLIGENCE

Objective: *The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to AI, AI Techniques, Level of Model, Criteria for Success, Turing Test. **Problems, Problem Spaces &Search:** Defining Problem as a Space, Search, Production System, Problem Characteristics, Production System Characteristics, Issues in the Design of Search Programs. **Heuristics Search Strategies:** Generate and Test, Hill Climbing, Best First Search (A*), Problem Reduction (AO*), Constraint Satisfaction, Means Ends Analysis. **Knowledge Representation Issues:** Representations and Mappings, Approaches to knowledge Representation, The Frame Problem, Semantic Network, Frame Representation. **Using Predicate Logic:** Representing Simple Facts in Logic, Representing Instance and is-a Relationship, Computable Functions and Predicates, Resolution, Natural Deduction.	20
II	**Representing Knowledge Using Rules:** Procedural Vs Declarative knowledge, Logic Programming, Forward and Backward Searching, Matching knowledge Representation. **Game Playing and Search:** Introduction, Min-Max algorithm, Alpha-Beta Cut Off, Example of Games. **Intelligent Systems:** Learning Model, Types of Learning, Components of an Expert System, Categories of Expert System, Stages of Development of Expert System, Expert System Development Tools, Overview of Fuzzy Systems, ANN, Swarm Intelligent Systems.	20

Text Book:

- S. Russell and P. Norvig, "Artificial Intelligence: AModernApproach", 3rdEditionPrentice Hall

Reference Books:

- Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill
- Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India,
- E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education

Focus: This course focuses on Employability under CO1, CO3
Outcome: After completion of Lab, student will be able to:

- CO1: Understand basic concept of artificial intelligence and intelligent Agent.
- CO2: Differentiate between informed and uninformed search.
- CO3: Apply First Order Predicate Logic in reasoning.
- CO4: Understand Knowledge Representation.
- CO5: Explain decision tree and statistical learning.
- CO6: Understand rule and its application in Expert Systems.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcome(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3,PSO4
CO2	PO2/PSO3
CO3	PO1,PO3/PSO2,PSO3
CO4	PO2/PSO2,PSO3
CO5	PO1 /PSO3

CO6	PO2/PSO3,PSO4

MCAE0301: DATA MINING & WAREHOUSING

Objective: *The Objective of this course is to introduce the basic concepts of Data Warehouse and Data Mining techniques.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Overview, Motivation (For Data Mining), Data Mining-Definition & Functionalities, Data Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Computer And Human Inspection),Inconsistent Data, Data Integration and Transformation. **Data Reduction**: Data Cube Aggregation, Dimensionality Reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept Hierarchy Generation. **Data Warehousing**: Overview, Definition, Delivery Process, Difference Between Database System and Data Warehouse, Multi-Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept Hierarchy, Process Architecture, 3 Tier Architecture, Data Marting, Aggregation, Historical Information, Query Facility, OLAP Function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining Interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse. **Concept Description**: Definition, Data Generalization, Analytical Characterization, Analysis of Attribute Relevance, Mining Class Comparisons, Statistical Measures in Large Databases, Measuring Central Tendency, Measuring Dispersion of Data, Graph Displays of Basic Statistical Class Description, Mining Association Rules in Large Databases, Association Rule Mining, Mining Single-Dimensional Boolean Association Rules From Transactional Databases– Apriori Algorithm, Mining Multilevel Association Rules From Transaction Databases and Mining Multi-Dimensional Association Rules From Relational Databases.	21
II	**Classification And Predictions**:Whatis Classification & Prediction, Issues Regarding Classification and Prediction, Decision Tree, Bayesian Classification, Classification By Back Propagation, Multilayer Feed-Forward Neural Network, Back Propagation Algorithm, Classification Methods Knearest Neighbor Classifiers, Genetic Algorithm. **Knowledge Discovery, Data Mining Cluster Analysis:** Data Types in Cluster Analysis, Categories of Clustering Methods, Partitioning Methods. Hierarchical Clustering- CURE And Chameleon, Density Based Methods-DBSCAN, OPTICS, Grid Based Methods- STING, CLIQUE, Model Based Method –Statistical Approach, Neural Network Approach, Outlier Analysis, Multimedia Data-Mining, Multimedia-Databases, Mining Multimedia Data, Data-Mining And The World Wide Web, Web Data-Mining, Mining And Meta-Data, Data Visualization & Overall Perspective, Data Visualization, Applications of Data-Mining.	19

Text Books:

- Jiawei Han, MichelineKamber ," Data Mining Concepts& Techniques", 3rdEdition, Morgan Kauffmann,2013.

Reference Books:

- M. H. Dunham , "Data Mining: Introductory and Advanced Topics", 1st Edition, Pearson Education,2003.

- Sam Anahory, Dennis Murray , "Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems", 4th Edition, Pearson Education,2009.
- Pang-Ning Tan, Michael Steinbach, Vipin Kumar (), "Introduction to Data Mining", 2ndEdition, Addison-Wesley.2006.
- Aggarwal, , "Data Mining: The Textbook", Springer,2015.

Focus: This course focuses on Employability under CO1, CO2, CO5

Outcome: After the completion of this course, student will be able to:

- CO1: Understand and apply the concept of data warehouse and mining in real-life applications.
- CO2: Apply the principle algorithms used in modern machine learning.
- CO3: Apply the information theory and probability theory to get the basic theoretical results in Data Mining.
- CO4: Apply Data mining algorithms to real datasets, evaluate their performance and appreciate the practical issues involved.
- CO5: Implement clustering using various clustering methods on data set.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3,PO4/PSO1,PSO3
CO3	PO1 /PSO1
CO4	PO1 /PSO2
CO5	PO3/PSO2

MCAE0302: BUSINESS INTELLIGENCE

Objective: *The objective of this course is for the students to achieve a profound understanding of Business Intelligence (BI) systems in terms of its tools, current practices and impacts.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Business Intelligence:** Introduction to Digital Data and Its Types – Structured, Semi-Structured and Unstructured, Introduction to OLTP and OLAP (MOLAP, ROLAP, HOLAP), BI Definitions & Concepts, BI Framework, Data Warehousing Concepts and Its Role in BI; BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities, Business Applications of BI, BI Best Practices. **Basics of Data Integration (Extraction Transformation Loading):**Concepts of Data Integration, Needs and Advantages of using Data Integration, Introduction to Common Data Integration Approaches;	13
II	**Introduction to Multi-Dimensional Data Modeling:**Introduction to Data and Dimension Modeling, Multidimensional Data Model, ER Modeling vs. Multi-Dimensional Modeling, Concepts of Dimensions, Facts, Cubes, Attribute, Hierarchies, Star and Snowflake Schema, Introduction to Business Metrics and KPIS, Creating Cubes using Microsoft Excel. **Basics of Enterprise Reporting:**A Typical Enterprise, Malcolm Bridge - Quality Performance Framework, Balanced Scorecard, Enterprise Dashboard, Balanced Scorecard vs. Enterprise Dashboard, Enterprise Reporting using MS Access / MS Excel, Best Practices in the Design of Enterprise Dashboards.	13

Text Books:

- RN Prasad and Seema Acharya , “Fundamentals of Business Analytics”, Wiley India, 2nd Edition,2018.

Reference Books:

- U Dinesh Kumar , “Business Analytics: The Science of Data - Driven Decision Making”, Wiley India, 1st Edition,2017.
- David Loshin , “Business Intelligence”, 2nd Edition, Elsevier Science & Technology,2012.
- Mike Biere , “Business Intelligence for the Enterprise”, Pearson,2010.
- IBM , “An Introduction to Building Data Warehouse”, Prentice Hall of India,2004.
- Larissa Terpeluk Moss &ShakuAtre , “Business Intelligence Roadmap”, Pearson,2003.

Focus: This course focuses on Employability under CO1 CO2, CO5

Outcome: At the end of this course, student will be able to

- CO1: Identify the major frameworks of computerized decision support: decision support systems (DSS), data analytics and business intelligence (BI).
- CO2: Explain the foundations, definitions, and capabilities of DSS, data analytics and BI.
- CO3: Design tested and effective advanced analytics models and simulations for decision making.
- CO4: Understand the methodology of engineering legacy databases for business intelligence to derive business rules for decision support systems.
- CO5: Articulate assumptions, analyses, and interpretations of data in an oral formatApply big data technologies in business intelligence using geospatial data, location-based analytics, social networking, Web 2.0, reality mining, and cloud computing.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/PSO1
CO2	PO1,PO2/PSO3
CO3	PO1/PSO1,PSO3
CO4	PO3,PO6/PSO1,PSO4
CO5	PO2,PO3/PSO2

MCAE0303: INFORMATION RETRIEVAL SYSTEMS

Objective: *This course aims to give students an understanding of the fundamental techniques for hyper-media architectures, design and usability, document management and retrieval, meta data management, and searching the web.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Information Retrieval:** IR basic concepts, Information & Data Retrieval, Applications of IR, Web Search Basics, Web Characteristics & Web Graph, Introduction to Web Structure, Content, Usage Based Retrieval, Search Engines Working Approach,Web Crawling & Indexing- Crawling Architecture, Crawling Features, Link Analysis, Web Graph, Hubs and Authorities, Page Rank Computation. **Basic IR Models**: Basic Modeling concepts, Boolean model, Vector Model, Evaluation of IR- Scoring, TF-IDF, Term Weighting, Recall & Precision. **Retrieving User Behavior from the Web:** Uncovering Patterns in Web, Content & Structure Pattern Mining, Web Usage Mining Architecture-Preprocessing Tasks,DataCleaning,Transaction Identification, Discovery Techniques on Web Transactions -Path Analysis,AssociationRules,Sequential Patterns, Web Usage Mining Components, Integrating Content and Usage Profiles for Personalization, Practical Web Mining Issues and Applications.	13
II	**Parallel &Distributed IR:** Parallel & Distributed IR Architecture, Collection partitioning &Clustering- Flat Clustering and Hierarchical Clustering, Multimedia IR Models & languages. **Text & Query Languages:** Query Types, Keyword based querying, Structural queries, Metadata, Text & markup languages, Text operations & Document Preprocessing, Indexing & searching, Inverted files, Suffix Trees & Suffix Arrays. Term Vocabulary- Determining the Vocabulary of Terms, Search Structures for Dictionaries, Wild Card Queries, Designing Parsing and Scoring Functions. **XML Retrieval:** Basic XML Concepts, Extracting Data from Text, Text Centric & Data Centric Retrieval. Vector space model for XML retrieval, Evaluation of XML retrieval, Web Parsing Techniques- DOM, SAX, Transformation Engines and Filters, Data Binding.	14

Textbook:

- Christopher D. Manning, PrabhakarRaghavan and HinrichSchütze , "Introduction to Information Retrieval", Cambridge University Press,2009.

Reference Books:

- Ricardo Baeza-Yate, Berthier Ribeiro-Neto,"Modern Information Retrieval",2nd Edition, Addison Wesley,2011.
- SoumenChakrabarti , "Mining the Web: discovering knowledge from hypertext data", 2nd Edition, Morgan Kaufmann,2002.
- David A. Grossman, Ophir Frieder , "Information Retrieval: Algorithms, and Heuristics",2nd Edition, Springer,2004.

Focus: This course focuses on Employability under CO1,CO2,CO3 & CO4

Outcome: After successful completion of this course, students should be able to:

- CO1: Apply different information retrieval techniques in real life application.
- CO2: Analyze indexing and pre-processing of textual documents for IR system.

- CO3: Apply IR principles into Spelling Correction, Phonetic Correction.
- CO4: Analyze performance of retrieval systems.
- CO5: Apply IR techniques to XML Retrieval.
- CO6: Implement retrieval systems for web search tasks.
- CO7: Demonstrate similarity computation using link analysis.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO3
CO2	PO2,PO4/PSO4
CO3	PO1,PO3,PO4/PSO4
CO4	PO3,PO4/PSO1,PSO4
CO5	PO1,PO2,PO5/PSO1
CO6	PO3,PO5 /PSO1,PSO4
CO7	PO2,PO3,PO5/PSO2

MCAE0304: BIG DATA AND ANALYTICS

Prerequisite: *Exposure to any object oriented programming language (such as Java) and basic operational knowledge of any RDBMS (such as MySQL)*

Credits: 03 **L-T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Big Data technology Landscape**: Types of Digital Data (Structured, Semi-Structured, Unstructured),Concept, importance and characteristics of data, Challenges with big data, Big data stack, Big Data 1.0, 2.0 and 3.0, Traditional BI vs. Big Data Environment, NoSQL Databases, NoSQL Vs. RDBMS, New SQL, Introduction to Data Science/Scientist **HADOOP 1.0:** Introducing Hadoop 1.0, Limitations of RDBMS, Hadoop Components, High Level Architecture of Hadoop, History of Hadoop, Special Features of Hadoop, Introduction to HDFS 1.0, Architecture, Daemons, Working with HDFS Command, Introduction to Map-Reduce 1.0, Architecture, Daemons **HADOOP 2.0:** Introducing Hadoop 2.0, Limitations of 1.0, Introduction to HDFS 2.0, Architecture, Daemons, Introduction to Map-Reduce 2.0, YARN, Architecture, Daemons, Word Count Example using Java, Introduction to Hadoop 3.0, Difference among Hadoop1.0, Hadoop2.0, Hadoop3.0 **Introduction to Mongo DB**: RDBMS vs. MongoDB, JSON, Unique Key, Dynamic Queries, Sharding, Replication, MongoDB QL: Create, Drop Database and Collections, CRUD: Create, Insert, Find, Update, Delete, Map Reduce Programming, Aggregations	20
II	**Introduction to Cassandra DB**: Features of Cassandra, CQL Data Types, CQLSH: CRUD, Counter, TTL, List, Set, Map, Tracing, Import Export csv files **Introduction to Neo4j:** Why graph DB, RDBMS vs. Graph DB, Advantages, Features, Graph Data Model, Neo4j Building Blocks, Neo4j CQL: CQL Clause, CQL Functions, Creating Relationships **HADOOP Ecosystem and Flume:** Introduction to Hadoop Ecosystem, Sqoop, Zookeeper, Plug-in Components: Impala, Hue, Flume: Introduction, Application, Advantage, Features, Streaming/ Log Data, Architecture, Data Flow, Creating a Twitter Application. **Introduction to HIVE:** Hive Architecture, Hive Data types, Hive Collection Types, Hive File Formats, Hive Query Language, Hive Partitions, Bucketing, Views, RCFile Implementation, Hive User Defined Function, SerDe, UDF **Introduction to Pig:** History and Anatomy of Pig, Pig on Hadoop, Use Case for Pig, Pig Primitive Data Types, Pig Latin Overview, Execution Modes of Pig, Field, Tuple, Bag, User Defined Function, Parameters in Pig, Piggy Bank, Word count example using Pig, Pig vs Hive, When to use Pig.	20

Text Book:

- Seema Acharya and SubhashiniChellappan, “Big Data and Analytics”, 1st Edition, Wiley, India,2015.
- Jure Leskovec, AnandRajaraman, Jeff Ullman, “Mining of Massive Datasets”, 2nd Edition, 2014, Cambridge University Press.

Reference Books:

- Chuck Lam, “Hadoop in Action”, 2nd Edition, 2014, Manning Publications.

Focus: This course focuses on Employability under CO 1, CO2, CO3 & CO4.

Outcome: At the end of the course, student will be able to

- CO 1: Understand the concepts and challenges of big data.
- CO 2: Apply existing technology to collect, manage, store, query, and analyze the big data.
- CO 3: Apply job scheduling of various applications and resource management using Hadoop and Yarn.
- CO 4: Apply the data summarization, query, and analysis of big data using pig and hive.

- CO 5: Design the regression model, cluster and decision tree of big data.
- CO 6: Experiment with hands-on experience in large-scale analytics tools to solve big data problems.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO3/PSO4
CO3	PO3,PO5/PSO4
CO4	PO3,PO5/PSO4
CO5	PO3/PSO2
CO6	PO2/PSO4

MCAE0305: INTERNET OF THINGS

Objective: *To Implement Data and Knowledge Management and use of Devices in IoT Technology.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to IoT:** Introduction to IoT- Sensing, Actuation, Logical design of IoT, Functional blocks of IoT, Communication models, IoT& M2M: Machine to Machine, Difference between IoT and M2M, **Introduction to Sensors:** About Sensor, Properties of Sensors, Basic physical principles of sensing, Categorization of Sensor, PIR Sensor, Temperature Sensor, Ultrasonic Sensor, IR Sensor, MQ2/MQ3 **Implementing IoT** Introduction to different IoT Tools, Introduction to Arduino Programming. Integration of Sensors and Actuators with Arduino.	20
II	Implementation of IoT with Arduino, Node MCU and Raspberry Pi. Mini project Statement using Node MCU. **IoT Over Network** IOT Networking Protocols: TCP/IP, 6LowPan, RPL, Thread. **Communication Protocol:**CoAP, SMTP, HTTP, HTTPS, MQTT, MQTT-S SDN for IoT, Implementing web server. Tools for data handling using web services. Data Handling and Analytics in Cloud and Fog Computing.	20

Books for reference:

- "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
- "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)

Focus: This course focuses on Employability under CO 1, CO3,CO7

Outcome:
- CO1: Understand the concepts of Internet of Things.
- CO2: Understand difference between Sensors and Actuators and their working principles.
- CO3: Design IoT applications using different sensors and actuators.
- CO4: Understand different protocols used in IoT over network.
- CO5: Understand different communication protocols.
- CO6: Explain the concept of cloud computing and fog computing.
- CO7: Implement IoT application using Raspberry Pi.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO2 /PSO4
CO3	PO5/PSO2
CO4	PO11/PSO2
CO5	PO1,PO3/PSO4
CO6	PO2/PSO1
CO7	PO5/PSO3

MCAE0306: CLOUD COMPUTING

Objective: *This course covers aims to explain various technologies related to Cloud Computing and their practical implementations, discuss different architectural models of cloud computing, the concepts of virtualization and cloud orchestration.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Overview of Cloud Computing -** Brief history and Evolution of Cloud Computing, Traditional vs. Cloud Computing, Importance of Cloud Computing, Cloud service models (IaaS, PaaS & SaaS). Cloud deployment models (Public, Private, Hybrid and Community Cloud), Benefits and Challenges of Cloud Computing. **Working with Private Cloud –** Concept of Hypervisor, Basics of virtualization, Virtualization technologies, Server virtualization, VM migration techniques, Role of virtualization in Cloud Computing. Business cases for the need of Cloud computing environment, Concept of Private Cloud, Characteristics of Private Cloud, Private Cloud deployment models, Private Cloud Vendors, Private Cloud Building blocks (Physical Layer, Virtualization Layer, Cloud Management Layer), Virtual Private Cloud. Case study on (one out of CloudStack, OpenStack, Eucalyptus, IBM or Microsoft). **Working with Public Clouds –** Concept of Public Cloud, Importance of Public Cloud, When to opt for Public Cloud, Public Cloud Service Models, and Public Cloud players. Infrastructure as a Service Offerings, IaaS Vendors, PaaS offerings, PaaS vendors, Software as a Service. Implementing public cloud (one out of AWS, Windows Azure, IBM or Rackspace)	20
II	**Overview of Cloud Security -** Security concerns in Traditional IT, Challenges in Cloud Computing in terms of Application, Server, and Network Security. Security reference model, Abuse and Nefarious Use of Cloud Computing, Insecure Interfaces and APIs (Malicious Insiders, Shared Technology Issues, Data Loss or Leakage, Account or Service Hijacking, Unknown Risk Profile), Attacks in Cloud Computing, Vendors offering Cloud Security for public and private clouds. **Overview of Multi-Cloud Management Systems -** Explain concept of multi-cloud management, Challenges in managing heterogeneous clouds, benefits of multi-cloud management systems. Case study on Multi-Cloud Management System (Right Scale Cloud Management System) **Business Clouds -** Cloud Computing in Business, Various Biz Clouds focused on industry domains (Retail, Banking and Financial sector, Life Sciences, Social networking, Telecom, Education). Cloud Enablers (Business Intelligence on cloud, Big Data Analytics on Cloud), Role of Cloud computing in SCM and CRM. Future directions in Cloud Computing - Future technology trends in Cloud Computing with a focus on Cloud service models, deployment models, cloud applications, and cloud security. Migration paths for cloud, Selection criteria for cloud deployment. Current issues in cloud computing leading to future research directions	19

TextBooks:

- Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski , Cloud Computing: Principles and paradigms,2011.

ReferenceBook:

- Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter Cloud Computing: A Practical Approach,2010.
- McGraw Hill. Rittinghouse, John, W, Cloud computing: Implementation, management and security.
- Barrie Sosinsky , Cloud Computing Bible, Wiley,2011.
- Rhoton, John, Cloud Computing Architected: Solution Design Handbook.
- Krutz, Ronald L.; Vines, Russell Dean, Cloud Security, A comprehensive Guide to Secure Cloud Computing.

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After successful completion of this student will be able to:

- CO1: Describe importance of virtualization along with their technologies like system, network, and storage virtualizations.
- CO2: Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, XaaS, Public Cloud, Private Cloud, Hybrid Cloud and the core issues of cloud computing such as security, privacy, and interoperability.
- CO3: Justify the need of new technology of Virtualization & Cloud Computing and its ecological impact.
- CO4: Identify the known threats, risks, vulnerabilities and privacy issues associated with Cloud based IT services
- CO5: Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost
- CO6: Identify the Challenges in managing heterogeneous clouds.
- CO7: Analyze various cloud programming models and apply them to solve problems on the cloud.
- CO8: Describe the key components of Amazon web Service

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO7/PSO2
CO2	PO1,PO3,PO7/PSO1
CO3	PO1,PO7/PSO1
CO4	PO1,PO3,PO5/PSO4
CO5	PO1,PO3,PO5,PO7/PSO4
CO6	PO1,PO3,PO5 /PSO2
CO7	PO1,PO3,PO5/PSO1
CO8	PO1,PO3,PO5,PO7/PSO1,PSO2

MCAE0370: BIG DATA AND ANALYTICS LAB

Objective: This course introduces students to R, a widely used statistical programming language. Students will learn to manipulate data objects, produce graphics, analyse data using common statistical methods, and generate reproducible statistical reports. Student will also learn data mangling.

Credits: 01 **L-T–P: 0–0–2**

Module No.	Content	Lab Hours
I	**Module 1: Introduction to R** • Introduction and installation of R and RStudio • Data types, vectors, multidimensional array. • Functions and their use • Visualization using ggplot2. • Word-Count program using Java	24
II	**Module 2: Hands-On MongoDB, Cassandra** • Installation of VM-Ware and Cloudera • Hands-On Mongo DB: CRUD, Where, Aggregation • Hands-On Mongo DB: Projection, Aggregation • Hands-On Cassandra DB: CRUD, Projection **Module 3: Hands-On MapReduce** • Hands-On PIG • Hands-On HIVE • Twitter Data Fetching using Flume	

Reference Books:

- Paul Teetor. R Cookbook: Proven recipes for data analysis, statistics, and graphics. O'Reilly Media, Inc.,2011.
- Norman Matloff. Theart of R programming: A tour of statistical software design. No Starch Press, 2011.
- Winston Chang. R graphics cookbook. O'Reilly Media, Inc., 2012.
- Hadley Wickham and Garrett Grolemund. R for data science. 2016.
- Phil Spector. Data manipulation with R. Springer Science& Business Media, 2008.

Focus: This course focuses on Employability under CO1, CO2.

Outcome: At the end of the course, student is able to:

- CO1: Apply R-Studio, read R documentation, and write R scripts.
- CO2: Analyse the data using data analytics latest tools based on HDFS like Pig, Hive.
- CO3: Implement the aggregation projection on data set using Cassandra, MongoDB.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO5/PSO4
CO2	PO1,PO5/PSO3
CO3	PO2,PO5/PSO3

MCAE0371: INTERNET OF THINGS LAB

Objective: *Coordinate and help to increase and optimize the utilization of results and value creation in the area of IoT*.

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I/II	• WAP to interface and blink the LED using Arduino UNO. • WAP to interface for different sensors (Like DHT11, temperature, IR, Ultrasonic etc) to Arduino UNO. • WAP to interface temperature sensor to ESP8266. Turn on the LED if temperature value met threshold value. • WAP to interface in between Bluetooth module and Arduino UNO. • Write a python program for Gateway to store sensor data on local MySQL database. • WAP to transmit the data wirelessly for longer distance using multi-hop technique. • Configure the gateway as local MQTT broker (Mosquitto), configure one ESP8266 as sender (Publisher), and receive the data on the Smartphone (MQTT Dashboard).	12*2=24

Text Books:

- Upskill Learning), "ESP8266: Programming NodeMCU Using Arduino IDE - Get Started With ESP8266 (Internet Of Things, IOT, Projects In Internet Of Things, Internet Of Things for Beginners, NodeMCU Programming, ESP8266)",2018.

Focus: This course focuses on Employability under CO1, CO2.

Outcome: After completion of course, student will be able to:

- CO1: Design IoT applications using different sensors and actuators.
- CO2: Design IoT applications in different domain and be able to analyze their performance.
- CO3: Implement basic IoT applications on embedded platform.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO3,PO5/PSO1
CO2	PO4/PSO1
CO3	PO1/PSO4

MCAE0372: CLOUD COMPUTING LAB

Objective: *This lab aims to understand the concept of cloud and virtualization by the help of VMware.*

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I/II	• 1. a) Introduction to Packet Tracer. • b) Network Topologies. (Including explanation of Simple PDU & Complex PDU.) • 2. Connecting 3 netwoks using routers. Also, configure DHCP and DNS server. • 3. Configuration of different Application services (SMTP, FTP, HTTP, TFTP, DHCP & DNS) • 4. Configuration of Vlan and Inter- Vlan Routing. • 5. Configure GRE over IP tunnel (VPN). • 6. Static NAT configuration. • 7. Configure Wireless network. • 8. Configure different IoT devices. • 9. Study on VMware • a. Creating a VM • b. Networking on VM • c. Merging and splitting disk on VM • d. Cloning the guest OS • e. Deploying VM with template • f. Creating Snapshots • g. Managing Users, Groups, Permissions and Roles • 10. Crating a EC2 instance on AWS • 11. Configuration of db in AWS. • 12. Creation of S3 bucket with single IAM user in AWS.	12*2=24

Reference Book:

- Raj Kumar Buyya, James Broberg, Andrezei, M. Goscinski , Cloud Computing: Principles and paradigms,2011.

Focus: This course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of Lab, student will be able to:

- CO1: Understanding about the virtualization by the help of VMware.
- CO2: Understanding of CISCO packet tracer to build a cloud network infrastructure.
- CO3: Explain the key components of Amazon web Service and Microsoft Azure.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/PSO1
CO2	PO1,PO3,PO5/PSO1
CO3	PO1,PO3,PO5,PO7/PSO2

MCAE0402: .NET FRAMEWORK USING C#

Objective: *To understand the concepts of dot net framework and its technologies in programming which provide students with the means of writing efficient, maintainable, and portable Website.*

Credits: 03 **L–T–P–J: 3–0–0–0**

Module No.	Content	Teaching Hours
I	**Introduction of Dot Net Frame Work:**Introduction, Architecture of Frame work, Common Language Runtime and Architecture, Common Type System, Common Language Specification, The Base Class Library, Just-in-Time Compilation, Garbage Collection. **Introduction of C# with Feature:**Data Types, Identifiers, Variables & Constants, C# Statements, Object Oriented Concept, Object and Classes, Arrays and Strings, Delegates and Events, Properties and Indexer. Input Output, Multi-Threading, Networking and Sockets,Unsafe Mode, Generic Classes, Unified Class, Error -handling.	20
II	**Assemblies:** Its Feature and Structure, Types of Assembly **-** Private and Shared. **Advanced Concepts:**ComponentBased and Web Based Application. **Attribute:**Built-In Attribute and Custom Attribute,ADO.NET, Web Services, Windows Services. **Graphical Device Interface**: Vector2D, Typography and Imaging, Anti-Aliasing.	19

Text Books:

- ShibiPanikkar and Kumar Sanjeev "C# with .NET Frame Work". FirewallMedia, 2009.
- Shildt "C#: The Complete Reference. C#3.0", Tata McGraw Hill Publication, 2010.

Reference Books:

- Jeffrey Richter "Applied Microsoft .Net Framework Programming**"**, Microsoft.
- Wiley "Professional C#",Wrox Publication, 2011.
- Shildt, "C#: The Complete Reference ADO.NET**",** Tata McGraw Hill Publication.

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of course, student will be able to:

- CO1: Understanding architecture of visual studio.net.
- CO2: Understand object oriented concept with exception handling using c# language.
- CO3: Understand multithreading, file handling and concept generic classes.
- CO4: Understand structure of assembly with built in attributes
- CO5: Develop window services and web service as advance concept
- CO6: Understand graphics based programming and image processing.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/PSO1
CO2	PO1,PO3/PSO1, PSO2
CO3	PO1,PO3/PSO2, PSO4
CO4	PO1/PSO1
CO5	PO1,PO3/PSO2, PSO4
CO6	PO1,PO5/PSO1, PSO4

MCAE0403: MOBILE APPLICATION DEVELOPMENT

Objective: *To gain a basic understanding of mobile platforms, emulators and mobile design principles.*

Credits: 03 **L–T–P–J :3–0–0–0**

Module No.	Content	Teaching Hours
I	**Preliminaries -** Introduction & need for Mobile Appsdevelopment, Example, Mobility concept, Mobile structure and characteristics. **Getting started with Mobility -** Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android platform, setting up the mobile app development environment along with an emulator, a case study on Mobile app development **Building blocks of mobile apps -** App user interface designing – mobile UI resources (Layout, UI elements, Draw-able, Menu), Activity- states and life cycle, interaction amongst activities. **App functionality beyond user interface -** Threads, Async task, Services – states and life cycle, Notifications, Broadcast receivers, Telephony and SMS APIs **Native data handling** – on-device file I/O, shared preferences, mobile databases such as SQLite, and enterprise data access (via Internet/Intranet)	19
II	**Taking apps to Market -** Versioning, signing and packaging mobile apps, distributing apps on mobile market place. **Sprucing up mobile apps -** Graphics and animation – custom views, canvas, animation APIs, multimedia – audio/video playback and record, location awareness, and native hardware access (sensors such as accelerometer and gyroscope) **Testing mobile apps -** Debugging mobile apps, White box testing, Black box testing, and test automation of mobile apps, JUnit for Android, Robotium, MonkeyTalkCurrenttrends in Mobile Apps development.	19

References:

- Barry Burd, Android Application Development All in one for Dummies, Edition: I
- Teach Yourself Android Application Development In 24 Hours, Edition: I, Publication: SAMS

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of course, student will be able to:

- CO1: Understand different mobile application models/architectures and patterns.
- CO2: Describe the components and structure of a mobile development framework
- CO3: Apply a mobile development framework to the development of a mobile application.
- CO4: Deploy applications to the Android OS

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/PSO1
CO2	PO1,PO3/PSO1, PSO2
CO3	PO1,PO3/PSO2, PSO4
CO4	PO1/PSO1

MCAE0404: DIGITAL MARKETING AND TRANSFORMATION

Objective: *The objective of this course is to provide knowledge about the digital marketing and the industry trends correspondence to the concepts*.

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introductionto Digital Marketing** Modern Marketing- How Marketing Works, Fundamentals Channels- Awareness, Consideration & Decision Making, Building Integrated Marketing Plan, Lead Journey- From Prospect to Sales. **Website and Blogging** The Power Of Storytelling, Know Your Customer - Market And Content Research, Construct Prospective Buyer Personas & Journeys, Establishing The Content Ideation & Creation Framework, Creative Design Principles, Linking Blogs To Social Network (Conversation Blogs), Measuring And Optimizing Blog Performance, Importance Of Responsive Design, Leverage Landing Pages And Forms To Accelerate Conversion. **Content Promotion** SEO as an Art and as a Science, Ranking Algorithms, Website Audit, Optimizing Digital Assets & Metadata, Decoding Common Paid Media Platforms, Influencer Marketing, Black Hat, White Hat and Grey Hat SEO **Email Marketing** Types of Email (Promo/Trans/NL), ESP Setup & On-boarding, Permission Marketing, Subscriber welcome plan and journey, List segmentation and Management, Personalization and Responsive design, Multivariate Testing, E-commerce Integration, Deliverability and System reputation Management, System Integrations & Automations.	20
II	**Social Media Marketing** Social Ads Type and their Design Structure, Targeting strategy and planning – Laser/Broad, Effective targeting and custom audience set-up, Campaign setup and reporting on various social platforms, Social Split Advertising, Content Calendar, Peremptory traits for Social Advertising PPE, WC and CTW campaigns. **Mobile Marketing** Mobile landscapes for Marketing and Monetization, Conventional Advertising, Millennial Mobile Advertising, Versatile Promotions, Alternative focusing and promotions on Mobile, Push App and Game based promotions, Location evolution with mobile **Marketing Analytics & ROI** Key marketing engagement & ROI metrics, Primer on data science and analytics concepts, Web Traffic nuances, Multi-channel Analytics, Decoding CLV and RFM, Deciphering conversion and goal metrics, Implement conjoint analysis & decision tree tactics, Avoiding common analytical pitfalls.	19

Text Book:

- Puneet Singh Bhatia, Fundamentals of Digital Marketing First Edition, Publication Pearson.

Reference Books:

- Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted and Measurable Online Campaigns, Publication Wiley India Pvt Ltd.
- Philip Kotler, HermawanKartajaya, IwanSetiawan, Marketing 4.0: Moving from Traditional to Digital, , Publication Wiley India Pvt Ltd.
- Vandana Ahuja, Digital Marketing 1st Edition, Publication Oxford.
- Rohan Yamagishi, Digital Marketing in Asia: A Start-Up Guide for Search Engine Marketing in APAC, Publication R. R. Bowker

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of course, student will be able to:

- CO1: Explain the role and importance of digital marketing in a rapidly changing business landscape.
- CO2: Describe and implement various methods for content promotion and website blogging.
- CO3: Understand the major digital marketing channels – email marketing.
- CO4: Describe the major social media marketing strategies that can be used to promote a company, brand, product, service or person.
- CO5: Understand mobile within digital marketing to develop your own mobile marketing strategies.
- CO6: Learn the measurement techniques used in evaluating digital marketing efforts and ROI.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO4,PO7,PO8/PSO1
CO2	PO1,PO4,PO7,PO8/PSO1
CO3	PO1,PO7,PO8/PSO1
CO4	PO1,PO7,PO8/PSO1
CO5	PO1,PO7,PO8/PSO3
CO6	PO1,PO4,PO7,PO8/PSO4

MCAE0471: .NET FRAME WORK LAB

Objective: *To implement various concepts of dot net framework technologies in algorithms.*

Credits: 02 **L–T–P–J: 0–0–4–0**

Module No.	Content	Lab Hours
I	• Working with OOPS concepts. • Code access security with C#. (Properties and Indexers). • Working with Delegates and Events on Console. • File handling with C#. • Working with multiple threads. • Using System.Net Web Client to retrieve or upload Data with C#. • Client Server Networking with TCP, UDP and Socket. • Working with Page and Forms using ASP.NET. • Data Base access model (Working with ADO.NET). • Creating Web Service and Consume in web based application.	48

Focus: This course focuses on Employability under CO1, CO2, CO3 & CO4.

Outcome: After completion of course, student will be able to:

- CO1: Develop the concept of object-oriented programming.
- CO2: Understand indexer, delegate, event, exception handling and multithreading concept by writing effective C# code.
- CO3: Develop connected and disconnected data access using ADO.NET.
- CO4: Develop web applications using ASP.NET Web Forms.
- CO5: Develop background services and Web Services.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO5/ PSO1, PSO2
CO2	PO1,PO3/PSO1, PSO2
CO3	PO1,PO3/ PSO1, PSO2
CO4	PO1/ PSO1, PSO2
CO5	PO1,PO3/ PSO1, PSO2

ऋते ज्ञानान्न मुक्तिः

GLA University, Mathura (U.P.)

Institute of Engineering and Technology

Department of Computer Engineering & Applications (CEA)

Course: M.Tech. (CSE)

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Programme Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals, researchers or entrepreneurs, for developing sustainable solutions.

PEO2: Attain positions of leadership in an organization and /or on teams.

PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Programme Outcome (POs)

A. **PO1: Engineering Knowledge:** Apply knowledge of mathematics and science, with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE.
B. **PO2: Problem Analysis:** Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
C. **PO3: Design/Development of solutions:** Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations.
D. **PO4: Conduct Investigations of Complex problems:** Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

E. **PO5: Modern Tool Usage:** Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations.

F. **PO6: The Engineer and Society:** Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice.

G. **PO7: Environment and Sustainability:** Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development

H. **PO8: Ethics:** Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice.

I. **PO9: Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings.

J. **PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.

K. **PO11: Project Management and Finance:** Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

L. **PO12: Life-Long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change.

Programme Specific Outcome (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.
PSO2: Design and develop hardware and software interfaces along with latest tools and technology to meet the needs of industry.
PSO3: Analyze the algorithmic principles, theory of computation and mathematical foundations for the modeling and design of computing systems.
PSO4: Apply knowledge to provide innovative solutions to existing problems and identify research gaps.

Contribution ***1: Reasonable*** ***2:Significant*** ***3: Strong***

Mapping of Programme Educational Objectives with Programme Outcome

A broad relation between the Programme Objective and the Outcome is given in the following table:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOME											
	A	B	C	D	E	F	G	H	I	J	K	L
PEO1	3	3	2	3	3	2	2	1	2	3	2	2
PEO2	3	3	3	2	2	3	3	3	3	3	3	2
PEO3	3	2	2	3	3	3	3	1	2	2	1	3

Mapping of Program Specific Objectives with Programme Outcome

A broad relation between the Program Specific Objectives and the Outcome is given in the following table:

PROGRAM SPECIFIC OBJECTIVES	PROGRAMME OUTCOME											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
PSO1	3	3	3	3	3	2	1	1	3	3	1	2
PSO2	3	3	3	2	3	2	1	1	3	3	2	2
PSO3	3	3	2	3	3	2	2	1	3	3	1	2
PSO4	3	3	3	3	3	2	1	2	3	3	3	3

COURSE STRUCTURE
M.TECH
COMPUTER SCIENCE & ENGINEERING

Under
Choice Based Credit System (CBCS)

First Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	Contact Hrs/wk
1	MCSC0001	Theory of Computation	4	0	0	4	4
2	MCSC0002	Software Engineering Methodologies	4	0	0	4	4
3	MCSC0003	Advanced Concepts in Data Mining	4	0	0	4	4
4	MCSC0004	Advanced Concepts in Networking	4	0	0	4	4
5	MCSC0005	Probability and Stochastic Processes	4	0	0	4	4
PRACTICALS							
6	MCSC0800	Problem Solving Lab - I	0	0	2	1	2
7	MCSC0801	Seminar-I	0	0	2	1	2
		TOTAL	**20**	**0**	**4**	**22**	**24**

Second Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	Contact Hrs/wk
1	MCSC0006	Mobile Ad-hoc Networks	4	0	0	4	4
2	MCSC0007	Intelligent Systems	4	0	0	4	4
3	MCSC0008	Information Retrieval	4	0	0	4	4
4	MCSC0009	Image Processing and Analysis	4	0	0	4	4
5	MCSC0010	Design of Distributed Systems	4	0	0	4	4
PRACTICALS							
6	MCSC0802	Problem Solving Lab - II	0	0	2	1	2
7	MCSC0803	Image Processing and Analysis Lab	0	0	2	1	2
8	MCSC0804	Seminar-II	0	0	2	1	2
		TOTAL	**20**	**0**	**6**	**23**	**26**

Third Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	Contact Hrs/wk
1		Elective-I	4	0	0	4	4
2		Elective - II	4	0	0	4	4
3	MCSJ0950	Dissertation – I	0	0	-	4	
4	MCSC0805	Colloquium	0	0	2	1	2
		TOTAL	**20**	**0**	**2**	**13**	**10**

Fourth Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1	MCSJ0951	Dissertation – II	0	0	-	14	-

Program Elective

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1	MCSE0001	Computer Vision	4	0	0	4	4
2	MCSE0002	Wireless Sensor Networks	4	0	0	4	4
3	MCSE0003	Software andService Oriented Architecture	4	0	0	4	4
4	MCSE0004	Pattern Recognition	4	0	0	4	4
5	MCSE0005	High Performance Computing	4	0	0	4	4
6	MCSE0006	Web Mining	4	0	0	4	4
7	MCSE0007	Machine Learning	4	0	0	4	4

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK
			L	T	P	J		
1.	MCSJ0950	Dissertation – I	0	0	0	0	4	-
2.	MCSJ0951	Dissertation – II	0	0	0	0	14	-
TOTAL			**0**	**0**	**0**	**0**	**18**	**0**

COURSE STRUCTURE
M.TECH (CSE)
PART TIME

First Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	Contact Hrs/wk
1	MCSC0001	Theory of Computation	4	0	0	4	4
2	MCSC0002	Software Engineering Methodologies	4	0	0	4	4
3	MCSC0005	Probability and Stochastic Processes	4	0	0	4	4
		PRACTICALS					
4	MCSC0800	Problem Solving Lab - I	0	0	2	1	2
5	MCSC0801	Seminar-I	0	0	2	1	2
		TOTAL	**12**	**0**	**4**	**14**	**16**

Second Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	Contact Hrs/wk
1	MCSC0007	Intelligent Systems	4	0	0	4	4
2	MCSC0009	Image Processing and Analysis	4	0	0	4	4
3	MCSC0010	Design of Distributed Systems	4	0	0	4	4
		PRACTICALS					
4	MCSC0802	Problem Solving Lab - II	0	0	2	1	2
5	MCSC0803	Image Processing and Analysis Lab	0	0	2	1	2
		TOTAL	**12**	**0**	**4**	**14**	**16**

Third Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	Contact Hrs/wk
1	MCSC0003	Advanced Concepts in Data Mining	4	0	0	4	4
2	MCSC0004	Advanced Concepts in Networking	4	0	0	4	4
3		Elective	4	0	0	4	4
		TOTAL	**12**	**0**	**0**	**12**	**12**

Fourth Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1	MCSC0006	Mobile Ad-hoc Networks	4	0	0	4	4
2	MCSC0008	Information Retrieval	4	0	0	4	4
3		Elective	4	0	0	4	4
PRACTICALS							
4	MCSC0804	Seminar-II	0	0	2	1	2
		TOTAL	**12**	**0**	**2**	**13**	**14**

Fifth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK
			L	T	P	J		
1.	MCSJ0950	Dissertation – I	0	0	0	0	4	-
2.	MCSC0805	Colloquium	0	0	2	0	1	0
TOTAL			**0**	**0**	**0**	**0**	**5**	**0**

Sixth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK
			L	T	P	J		
1.	MCSJ0951	Dissertation – II	0	0	0	0	14	-
TOTAL			**0**	**0**	**0**	**0**	**14**	**0**

SYLLABUS

MCSC0001: THEORY OF COMPUTATION

Objective: *Make students understand the fundamental questions of computer science:*

- *What problems can be solved by a computation?*
- *How hard is it to compute solutions?*
- *How can we express computation?*
- *Develop students' ability to understand and conduct mathematical proofs for computation and algorithms.*

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Chomsky Hierarchy of Grammars and the corresponding acceptors, Decidability – Decidable languages, The Halting Problem, Undecidable Problems about Turing Machines, Post's Correspondence Problem, Reducibility, Self-reference and the Recursion Theorem. **Complexity theory** - Measuring Complexity, Nontrivial examples of polynomial-time algorithms, The concept of a reduction, P, NP, and NP-completeness; the Cook-Levin Theorem, The P versus NP problem and why it's hard.	26
II	**Introduction to Cryptography** - Perfect secrecy and its limitations, Computational Approach to Cryptography, Computational security, one-way functions and pseudorandom generators, Pseudorandom generators from one-way permutations. Probabilistic Turing machines and their examples, One-sided and "zero-sided" error: RP, coRP, ZPP. Trapdoor one-way functions, Zero Knowledge Proofs, some applications - Pseudorandom functions, tossing coins over the phone and bit commitment, Secure multiparty computations, Lower bounds for machine learning. Probably approximately correct (PAC) learning, Introduction to Quantum, Quantum Mechanics and BQP.	26

References:

- Moore, Cristopher and Stephan Mertens , " The Nature of Computation. Oxford University Press" , 2011. ISBN: 9780199233212.
- Sipser, Michael, "Introduction to the Theory of Computation" , 2005. ISBN: 9780534950972.
- Arora, Sanjeev, and Boaz Barak. "Computational Complexity": A Modern Approach. Cambridge University Press, 2009. ISBN: 9780521424264.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome:

On successful completion of this course, students should be able to:

- CO1: Design, manipulate, and reason about formal computational models.
- CO2: Describe the limitations of different types of computing devices.
- CO3: Identify relations between classes of computational problems, formal languages, and computational models
- CO4: Account for the inherent complexity of many computational problems of practical importance
- CO5: Conduct formal reasoning about machines, problems and algorithms, including reduction-based proof

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO2, PSO3
CO2	PO5, PO8, PO9, PO11/ PSO4
CO3	PO3, PO4, PO5, PO11/ PSO1
CO4	PO6, PO7, PO8, PO10/ PSO3, PSO4
CO5	PO1, PO3, PO12/ PSO4

MCSC0002: SOFTWARE ENGINEERING METHODOLOGIES

Objective*: To understand the concepts and methods required for the development of large software intensive systems. Further, to provide an account of validation of various systems through formal methods.*

Credits:04 **Semester I** **L–T–P :4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Motivation – Software Attributes – Complexity - Software Metrics- Software Process, Requirement Engineering, Formal requirement specification, requirement modeling and specification Design Metrics and Configuration Management. Formal Specification and program verification, Software Process, Requirement Engineering, **Software Design Patterns** Issues in software design: modularity based cohesion & coupling Function oriented analysis & design. Software Architecture description languages - Product-line architectures; Component based development	26
II	**Software Quality Engineering** Testing Techniques – Test Case Generation, Software Maintenance schemes Software testing: strategies and assessment, COTS, Software reliability metrics & modeling, Software quality: models and assurance framework, Software Maintenance. **Introduction to formal methods** Formal Specifications Techniques – Verification and Validation – Theorem Provers - Model checking – Temporal logics – CTL & LTL and model checking **Software Metrics** - COTS Integration - Distributed, Internet-scale and Web-based Software Engineering **Empirical Studies of Software Tools and Methods** Software Reengineering - Software Reuse - Software Safety - Enterprise Architectures, Zachman's Framework; Architectural Styles.	26

References:

- Ghezzi, Jazayeri, Mandrioli, “Fundamentals of Software Engineering”, 2/E,Pearson ducation, 2002.
- Ian Sommerville , “Software Engineering”, 6/E,Pearson Education, 2006
- Roger S Pressman , “Software Engineering – A Practitioner’s Approach” ,6/E,MGH, 2005.
- Schmidt, Stal, Rohnert, and Buschmann , “Pattern-Oriented Software Architecture” Volume 2: Patterns for Concurrent and Network ed Objects”,Wiley, 2000.
- Len Bass, Paul Clements, Rick Katzman, Ken Bass , “Software Architecture in Practice”, 2/E, Addiwon –WesleyProfessional, 2003.

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcome:

- CO1: Develop, maintain and evaluate large-scale software systems
- CO2: Produce efficient, reliable, robust and cost-effective software solutions
- CO3: Critically evaluate assumptions and arguments
- CO4: Apply the principles, tools and practices of IT project management
- CO5: Manage time, processes and resources effectively by prioritizing competing demands to achieve personal and team goals
- CO6: Understand and meet ethical standards and legal responsibilities
- CO7: Rapidly learn and apply emerging technologies
- CO8: Understand the basic models of Software Quality and maintenance.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO11/ PSO1, PSO2
CO2	PO3, PO4, PO11/ PSO2, PSO3
CO3	PO4, PO5 / PSO3, PSO4
CO4	PO5, PO8, PO9, PO11 / PSO4
CO5	PO3, PO4, PO5, PO11/ PSO1
CO6	PO6, PO7, PO8, PO10 / PSO3, PSO4
CO7	PO1, PO3, PO12/ PSO4
CO8	PO1, PO2, PO11/ PSO3

MCSC0003: ADVANCED CONCEPTS IN DATA MINING

Objective:

- *To understand the advanced principles, concepts and applications of data mining*
- *To introduce the task of data mining as an important phase of knowledge recovery process.*
- *Analyze the data for various applications.*

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction of Data Mining:** Fundamentals, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining, Data Mining Primitives. **Association Rules:** Basic Concepts, Apriori Algorithm, Data Formats for Association Rule Mining, Mining with Multiple Minimum Supports- Extended Model and Mining Algorithm, Mining Class Association Rules- Problem Definition and Mining Algorithm. **Sequential Patterns:**Basic Concepts,Mining Sequential Patterns Based on GSP, GSP Algorithm, Mining Sequential Patterns Based on PrefixSpan- PrefixSpan Algorithm, Generating Rules from Sequential Patterns-Sequential Rules and Label Sequential Rules. **Supervised Learning:**Basic concepts. **Decision Tree Induction**: Learning Algorithm, Impurity Function, Classifier Evaluation- Evaluation Methods, Precision, Recall, F-score and Breakeven Point. **Classification Based on Associations:** Classification using Class Association rules, Class Association Rules as Features,	20
II	**Naïve Bayesian Classification**: Basic Concepts, Naïve Bayesian Text Classification,Probabilistic Framework, Naïve Bayesian Model. **Support Vector Machines**: Linear SVM, Nonlinear SVM, K-Nearest Neighbor Learning. **Unsupervised Learning:** Basic Concepts, K-means Clustering- K-means Algorithm, Disk Version of the K-means Algorithm. Representation of Clusters- Common Ways of Representing Clusters and Clusters of Arbitrary Shapes. **Hierarchical Clustering:** Single-Link Method, Complete-Link Method. **Distance Functions:** Numeric Attributes, Binary and Nominal Attributes, Text Documents, Data Standardization. Handling of Mixed Attributes,Which Clustering Algorithm to Use, Cluster Evaluation. **Partially Supervised Learning:** Learning from Labeled and Unlabeled Examples,EM Algorithm with Naïve Bayesian Classification,Co-Training, Self-Training.	20

References:

- Bing Liu, "Web Data Mining", First Edition,Springer, 2007.
- Jiawei Han and. Micheline Kamber "Data Mining – Concepts and Techniques", 3rd Edition Morgan Kaufmann, 2003.
- Arun K Pujari , "Data Mining Techniques", 2nd Edition University Press, 2010

Focus: This Course focuses on Employability under CO2,CO3,CO4.

Outcome:

- On successful completion of this course, students should be able to:
- CO1: Understand the concept of data warehouse and data mining.
- CO2: Apply the concept of data warehouse and data mining in real-life applications.
- CO3: Apply the principle algorithms used in modern machine learning.
- CO4: Apply the information theory and probability theory to get the basic theoretical results in Advanced Data Mining.

- CO5: Apply Advanced Data mining algorithms to real datasets, evaluate their performance and appreciate the practical issues involved.
- CO6: Implement supervised algorithms on data set.
- CO7: Implement unsupervised algorithms on data set.
- CO8: Implement ensemble based algorithms on data set.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2 /PSO1
CO2	PO3/PSO4
CO3	PO4/PSO3, PSO4
CO4	PO2/PSO3, PSO4
CO5	PO5/PSO4
CO6	PO2, PO5/PSO4
CO7	PO2, PO5/PSO4
CO8	PO2, PO5/PSO4

MCSC0004:ADVANCED CONCEPTS INNETWORKING

Objective: To make students understand the protocols, algorithms and tools needed to support the development and delivery of advanced network services over networks.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Networking overview, MAC layer issues, Ethernet 802.3, ARP, IP addressing and Subnetting, NAT and PAT, Variable Length Subnet Masking, CIDR **Advanced routing in the Internet and traffic engineering:** Intra domain routing: OSPF and IS-IS, Inter domain routing: BGP, Traffic Engineering **MPLS network**: MPLS basics, MPLS signaling, MPLS VPN **Internet multicasting:** IP multicasting, Application layer (Overlay) multicasting **TCP connection establishment and termination**: Sliding window concepts, other issues: wrap around, silly window syndrome, Nagle's algorithm, adaptive retransmission, TCP extensions. **End-to-End Congestion Control:** Tahoe, Reno, Vegas,	25
II	**Network based congestion control:** RED and ECN, Multicast congestion control. **Multimedia networking:** Introduction to multimedia networking, Video streaming over the Internet. **Internet QoS:** QoS fundamentals, Internet Differentiated services, Internet Integrated Services. **Peer-to-Peer networks and applications:** Peer-to-Peer file sharing networks, Peer-to-Peer streaming networks, Concept of overlays, Unstructured Overlays: Gnutella, Concepts of Distributed Hash Table, Structured Overlays: Chord, CAN, Pastry. **Wireless mobile networks:** Introduction to wireless networks, Wireless LAN, Cellular Networks, Mobile IP	25

References:

- Peterson and Davie ,"Computer Networks: A Systems Approach", 5th Edition MorganKauffman, 2011.
- Kurose and Ross ,"Computer Networking: Top Down Approach", 6th Edition. PearsonEducation, 2011.

Reading List

- V. Paxson, "End – to - end Internet packet dynamics," in IEEE/ACM Transactions on Networking, Vol. No. 3,June, 1999.
- W. Stevens, "TCP Slow Start, Congestion Avoidance, Fast Retransmit, and Fast Recovery Algorithms,"RFC2001.
- K.Fall and S. Floyd, "Simulation - based comparison of Tahoe, Reno, and SACK TCP," Computer Communication Review, vol. 26, pp. 5 - 21, July1996.
- L. Brakmo and L. Peterson, " TCP Vegas: End – to - End Congestion Avoidance on a Global Internet," IEEE Journal on Selected Areas in Communications, 13(8), October 1995, 1465 -- 1480.
- A. Rowstron, P. Druschel,"Pastry: Scalable, decentralized object location and routing for large - scale peer – to - peer systems". Middleware, 2001, 329—350.

Focus: This Course focuses on Employability under CO1,CO5,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand and explain Data Communications System and its components.
- CO2: Identify the different types of network devices and their functions within a network.
- CO3: Understand and building the skills of subnetting and routing mechanisms.

- CO4: Differentiate among flow control, congesting control and congestion avoidance.
- CO5: Demonstrate the different congestion control mechanism.
- CO6: Calculate congestion window size (cwnd) in TCP congestion mechanism.
- CO7:Understand and analyze the challenges of P2P networks and wireless networks.
- CO8: Explain the limitations of wireless networks.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO3/PSO1,PSO2
CO2	PO1,PO2,PO3,PO4/PSO1,PSO2
CO3	PO1,PO2,PO3,PO4/PSO1,PSO4
CO4	PO1,PO2,PO3,PO6/PSO1,PSO4
CO5	PO1,PO2,PO3/PSO1,PSO4
CO6	PO1,PO2,PO3,PO4/PSO1,PSO4
CO7	PO1,PO2/PSO1
CO8	PO1,PO2/PSO3

MCSC0005: PROBABILITY & STOCHASTIC PROCESSES

Objective: *To introduce the concepts of probability and stochastic processes and illustrate these concepts with engineering applications to support other courses and research in computer engineering.*

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I.	**Basic Probability:** Introduction, definitions of probability, set theory, axioms of probability, Conditional probability, Total probability and Bayes' theorem. **Random Variables:** Definition, Cumulative Distribution Function (CDF), continuous, discrete and mixed Random Variables, Probability Density Function (PDF), Probability Mass Function (PMF). **Properties of Random Variables:** Moments of Random variables: Mean and variance of random variable, Coefficients of variation, Skewness and kurtosis, Moments, Covariance and correlation coefficient. Properties of Distribution Functions,	21
II.	**Specific Random Variables:** Gaussian, Exponential, Rayleigh, Uniform, Binomial and Poisson Distributions. **Hazard Rate:** Definition, hazard rate of Exponential distribution, Gamma distribution, Weibull distribution. **Stochastic Processes:** Definition and Classification of Stochastic Processes, Poisson process, Birth and Death Process, Applications to Queues, Discrete Time Markov Chains, Limiting Distributions – Theory of M/M/1 and M/M/m queues – Little's Theorem	22

Text Books:

- Kishore S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Applications" Wiley

Reference Books:

- Papoulis, S. U. Pillai, "Probability, Random Variables and Stochastic Processes", Tata McGraw Hill
- A L Garcia, "Probability and Random Process for Electrical Engineers", Pearson Education
- R. M. Gray, L. D. Davisson , "An Introduction to Statistical Signal Processing", Cambridge University Press, 2004.
- H. Stark and J. W. Woods, "Probability and Random Processes with Applications to Signal Processing ", Pearson Education.
- P.Z. Peebles, "Probability, Random variables and Random signal principles", Tata McGraw Hill
- S L Miller, D G. Childers, "Probability and Random Processes", Academic press.
- Y. Viniotis, "Probability and Random Processes for Electrical Engineers", McGraw Hill.

Focus: This Course focuses on Employability and Skill Development under CO1,CO3,CO4.

Outcome: After completion of course, the student will be able to:

- CO1: have a general overview of statistical methods.
- CO2: know the principle definitions, fundamental theorems, and important relationships in statistics.
- CO3: Understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.
- CO4: Understand how random variables and stochastic processes can be described and analyzed
- CO5: Characterize probability models and function of random variables based on single & multiples

random variables.

- CO6: understand the role of probability theory as well as the concept of random variables and stochastic processes in information and communication technology.
- CO7: having competence in applying statistical methods to solve basic problems in information and communication technology.
- CO8: Understand the classifications of random processes and concepts such as strict stationarity, wide-sense stationarity and ergodicity.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 /PSO1, PSO2
CO3	PO4, PO5,PO6 /PSO3
CO4	PO2, PO3, PO4 /PSO1, PSO3
CO5	PO4, PO5, PO6 /PSO1, PSO3
CO6	PO3, PO4,PO5 /PSO1
CO7	PO5, PO6 /PSO3
CO8	PO1, PO2 /PSO1

MCSC0006: MOBILE AD-HOCNETWORKS

Objective: *This course will enable the students to understand the detailed concept related to Mobile Ad-hoc Networks.*

L–T–P: 4–0–0

Credits: 04

Semester II

Module No.	Contents	Teaching Hours
I	**Ad Hoc Wireless Networks:** Issues in Ad Hoc Wireless Networks, Ad Hoc Wireless Internet; **MAC Protocols for Ad Hoc Wireless Networks:** Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols; **Routing Protocols for Ad Hoc Wireless Networks:** Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Power Aware Routing Protocols.	26
II	**Transport Layer:** Issues and Design Goals, Split TCP, Ad-Hoc TCP, TCP-Bus Key Management. Secure Routing in Ad Hoc Wireless Networks **Energy Management in Ad Hoc Wireless Networks**: Classification of Energy Management Schemes, Transmission Power Management Schemes, System Power Management Schemes. **QoS in Ad-hoc Networks**: Issues, PHY, MAC, Network Layer Solutions Cross Layer Design	26

References:

- C S. Ram Murthy, B. S. Manoj ,"Ad Hoc Wireless Networks: Architectures and Protocols", Second Edition, Prentice Hall of India, 2005.
- R. Hekmat, "Ad hoc Networks: Fundamental Properties and Network Topologies", First Edition, Springer, 2006.
- B. Tavli and W. Heinzelman ,"Mobile Ad Hoc Networks: Energy Efficient Real Time Data Communications", First Edition, Springer, 2006.
- G. Anastasi, E. Ancillotti, R. Bernasconi, and E. S. Biagioni ,"Multi Hop Ad Hoc Networks from Theory to Reality", Nova Science Publishers, 2008.

Focus: This Course focuses on Employability under CO2,CO4,CO5,CO8.

Outcome: At the end of this course the students will be able to:

- CO1: Understand the need for ad hoc networks.
- CO2: Explain the constraints of physical layer that affect the design and performance of ad hoc network.
- CO3: Understand the concepts of protocols required for wired network may not work for wired network at MAC, Network and Transport Layer.
- CO4: Explain the operations and performance of different MAC layer protocols.
- CO5: Explain the different routing protocols proposed for ad hoc networks.
- CO6: Understand the basics of unicast and multicast routing protocols.
- CO7: Understand security issues and QoS requirements in MANETs.
- CO8: Explain about the energy management in adhoc networks.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO3/PSO1,PSO2
CO2	PO1,PO3,PO4/PSO1,PSO2
CO3	PO1,PO3,PO4/PSO1,PSO4
CO4	PO1,PO2,PO3/PSO1,PSO4
CO5	PO1,PO2/PSO1
CO6	PO1,PO3,PO4/PSO1,PSO4
CO7	PO1,PO2/PSO1
CO8	PO1,PO2/PSO3

MCSC0008: INFORMATION RETRIEVAL

Objective: *Introduce students to the basic concepts and techniques Web Mining for extracting knowledge from the web.*

Credits: 04 **Semester III** **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Concepts, Retrieval Process **Modeling** – A Formal Characterization of IR Models, Classic Information Retrieval (Boolean model, Vector Model, Probabilistic Model), Alterative Set Theoretic Models, Alternative Algebraic Models (Generalized Vector Space Model, Latent Semantic Indexing Model). **Query Languages and Operations**: Keyword based Querying, Pattern Matching, Structural Queries, and User Relevance Feedback. Text Operations: Document Pre-processing, Document Clustering, Text Compression.	26
II	**Evaluation in Information Retrieval:** Retrieval Performance Evaluation Recall, Precision, Mean average Precision, F-Measure, User Oriented Measures, Discounted Cumulated Gain. TREC Web Collections. **Searching the Web:** Characterizing the web, Crawling the Web, Mercator: A Scalable, Extensible Web Crawler, Parallel Crawlers, Different Types of Web Crawler, Anatomy of a Large-Scale Hyper textual Web Search Engine, Page Rank Algorithm. **IR Applications:** Summarization and Question Answering	26

References:

- Ricardo Baeza-Yate, Berthier Ribeiro-Neto, “Modern Information Retrieval”,Second Edition, Addison Wesly, 2011.
- G. G. Chowdhury , “Introduction to Modern Information Retrieval”, Second Edition, Neal-Schuman Publishers, 2003.
- David A. Grossman, Ophir Frieder, “Information Retrieval: Algorithms, and Heuristics”, Springer, 2004

Focus: This Course focuses on Employability under CO2,CO6,CO7.

Outcome: At the end of this course the students will be able to:

- **CO1:** Gain an understanding the basic concepts and techniques in Information Retrieval
- **CO2:**Apply different information retrieval techniques in real life applications.
- **CO3:** Understand the issues involved in representing and retrieving documents.
- **CO4:**Understand the latest technologies for linking, describing and searching the Web. - Understand the relationship between IR, hypermedia, and semantic models.
- **CO5:**Be able to apply and implement techniques for the preprocessing needed for information retrieval systems and can be able to develop a small information retrieval system.
- **CO6:**Apply the different evaluation strategies to the retrieved results for computing the efficiency and accuracy of the information retrieval model.
- **CO7:**Apply IR techniques to XML retrieval and develop retrieval system for web search tasks
- **CO8:**Demonstrate similarity computation for document retrieval.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO2, PSO3
CO2	PO1,PO3/PS1,PS3
CO3	PO2,PO3/PS2,PS3
CO4	PO1,PO3/PS1,PS2
CO5	PO1, PO2/PS2,PS3
CO6	PO1,PO2,PO3/PS2,PS3
CO7	PO1,PO3/PS1,PS3
CO8	PO2,PO3/PS1,PS2,PS3

MCSC0009: IMAGE PROCESSING AND ANALYSIS

Objective: *To cover the basic theory and algorithms that are widely used in digital image processing and analysis.*

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Digital Image Fundamentals:** Image sampling & quantization; Basic relationships between pixels, Some mathematical tools used in digital image processing. **Image perception:** Light, luminance, brightness and contrast, Human Visual System, Colour representation, Chromaticity diagram, Colour Coordinate Systems. **Image Enhancement:** Overview, Contrast Intensification, Smoothing, Sharpening, Basic intensity Transformation functions, Histogram processing, Spatial filters, Image Restoration **Image Transforms:** Discrete Fourier Transform, DCT Transform, KL Transform, Wavelet Transform. Image Enhancement in Frequency Domain	26
II	**Image Compression:** Fundamentals, Lossless Compression: Huffman Coding, Arithmetic Coding, Run-length Coding. Lossy Compression: JPRG Coding. **Image Registration:** Geometric Transformation, Registration by Mutual Information Maximization. **Image Analysis:** Fundamental concepts, Segmentation: Region extraction, Pixel based approach, Thresholding, Region based approach. Canny Edge Detection, **Feature Extraction:** Representation, Topological Attributes, Geometrical Attributes, Spatial Moments, Boundary based Description, Region based Description, and Intensity based Description. **Object Recognition:**Patterns and pattern classes, Recognition based on decision-theoretic methods, structural methods.	26

References:

- R. C. Gonzalez and R.E. Woods, "Digital Image Processing", Third Edition, Prentice Hall, 2011.
- Bhabatosh Chanda, D. Dutta Majumder, "Digital image processing and analysis**,** Second Edition, PHI, 2013.
- Anil K. Jain, "Fundamentals of Digital Image Processing"**,** Prentice-Hall, 2011.

Focus: This Course focuses on Employability under CO1,CO2,CO4.

Outcome:

- CO1: Understand the need for image transforms and their properties.
- CO2: Develop any image processing application.
- CO3: Learn different techniques employed for the enhancement of images.
- CO4: Learn the spatial and frequency domain techniques of image compression.
- CO5: Learn different feature extraction techniques for image analysis and recognition
- CO6: Learn different causes for image degradation and overview of image restoration techniques.
- CO7: Analyze images in the frequency domain using various transforms.
- CO8: Implement the image processing techniques in real world problems.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO2, PSO3
CO2	PO1,PO3/PSO1,PSO3
CO3	PO2,PO3/PSO2,PSO3
CO4	PO1,PO3/PSO1,PSO2
CO5	PO1, PO2/PSO2,PSO3
CO6	PO1,PO2,PO3/PSO2,PSO3
CO7	PO1,PO3/PSO1,PSO3
CO8	PO2,PO3/PSO1,PSO2,PSO3

MCSC0010: DESIGN OF DISTRIBUTED SYSTEMS

Objective: *To understand the fundamental principles, architectures, algorithms and programming models used in distributed systems and their extension in grid and cloud computing.*

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction, Types, Design Issues, Models ,Theoretical foundations of DS, Case Study of Amobea. **Distributed Mutual Exclusion:** Classification, Requirements, Performance Measurement, Non-Token Based Algorithm & Token Based Algorithm, Shared Memory based Mutual Exclusion **Communication in Distributed System:** Communication Between Distributed Objects, Events, Inter Process Communication- RPC, Distributed Objects and Middleware –Overview of trends. Challenges and Opportunities. **Distributed File Systems** –Introduction, Issues, Mechanism for building distributed file systems, Reliability & Performance in traditional DFS, Case Study – AFS, NFS, CODA **Failure Recovery:** Introduction, types, Recovery in concurrent and replicated distributed database system, Checkpoint Based Recovery **Fault Tolerance**: Issues, Commit Protocols, Voting Protocols	26
II	**Distributed Scheduling** – Issues in Load Distributing, Components, Stability, Load Distributing algorithm, Performance Comparison, Task Migration and issues **Distributed shared memory**-Architecture & Motivation, Memory coherence, Coherence Protocol, Design Issues Case Study- IVY **Distributed Web-Based Systems** – Architecture, Processes, Naming, Synchronization, Consistency and Replication **Distributed Coordination-Based Systems-** Introduction To Coordination Models, Architectures, Processes, Communication **Grid Computing** – Definition, Benefits, Issues, Types of Resources, Scheduling, reservation, and scavenging, Grid architecture models, Grid topologies, Case Study – Globus Toolkit **Cloud Computing** – Definition, Properties, Characteristics & Disadvantages, Cloud Computing Architecture, Service Models, Deployment Models, Resource Virtualization, Case Study – Amazon EC2	26

Text Book:

- Singhal & Shivaratri ,"Advanced Concept in Operating Systems", McGraw Hill, 2001

References:

- Coulouris, Dollimore, Kindberg , "Distributed System: Concepts and Design", Pearson Ed.Gerald Tel "Distributed Algorithms", Cambridge University Press, 2011.
- Tannenbaum , "Distributed Systems: Principles and Paradigms", Pearson Education, 2004.

Focus: This Course focuses on Employability under CO2,CO4,CO6.

Outcome:

- CO1: Understand basic elements and concepts related to distributed system technologies; and core architectural aspects of distributed systems.
- CO2:Identify the designing principles of distributed algorithms for different primitives like mutual exclusion, deadlock detection, and agreement.

- CO3:Understand principle behind IPC and use various interposes communication techniques, such as remote method invocation, remote events for building distributed systems.
- CO4:Introduce the concepts of distributed file system with its architecture and components along with case studies.
- CO5: Distinguish the main failure types in a Distributed System and specify algorithms for achieving fault tolerance and error recovery within such a system.
- CO6:Understand how balancing of resources is done; issues, components and algorithms for load balancing in distributed environment.
- CO7:Applying Grid and Web based techniques to support Distributed Systems.
- C 8. Applying Cloud based techniques to support Distributed Systems.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO2/PSO3
CO3	PO1/PSO1
CO4	PO3/PSO2
CO5	PO1, PO2/PSO3
CO6	PO1, PO2/PSO1, PSO3
CO7	PO5/PSO4
CO8	PO5/PSO4

MCSE0001: COMPUTER VISION

Objective: *To introduce the principles, models and applications of computer vision. To develop an appreciation for various issues in the design of computer vision and object recognition systems.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Overview to Computer Vision, Image formation – Geometric primitives and transformations, Photometric Image formation. **Digital Camera:** Sampling & aliasing, Colour, Compression, Camera model & caliberation, Epipolar Geometry, Stereopsis. **2D Shape –** Hough transform, Shape numbers, Pyramids, Quad Trees, Medial Axix Transform. **Recognition:** Detectors and Descriptors, clustering (K-Mean and Mean Shift), Interest Point Detection, Harris Corner Detector, SIFT, Template Matching, Detection with sliding windows: Viola Jones, Object recognition (Eigen faces, Active appearance models).	26
II	**Classification:**K-nearest Neighbours Algorithm, Statistical Classification, Bag-of-Words Models, Overview of methods for building Classifies, a part-based generative model (Constellation model) and a part-based discriminative model (Latent SVM). **Motion Analysis:** Motion estimation using Optic Flow, Video Change Detection, moving object detection - Background Subtraction approach, moving object detection using Gaussians Mixture Model (GMM) approach. Object Tracking, Kernel (Mean Shift) based Object Tracking, Motion Models to aid tracking (Kalman Filtering, particle filtering), Data Association, Applications of Object Tracking.	26

References:

- Richard Szeliski ,"Computer Vision: Algorithms and Applications", Springer, 2010.
- D.A. Forsyth and J. Ponce ,"Computer Vision: A Modern Approach", Prentice Hall, 2002
- Milan Sonka, Vaclav Hlavae, Roger Boyle , "Image Processing, Analysis and Machine Vision", Second Edition, Thomson, 2008.
- R. Hartley, and A. Zisserman ,"Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004
- R.O. Duda, P.E. Hart, and D.G. Stork ,"Pattern Classification" (2nd Edition), Wiley-Interscience, 2000

Focus: This Course focuses on Employability under CO1,CO2,CO5,CO6,CO8.

Outcome:

- CO1: Understand the basic knowledge, and methods of human and computer vision systems.
- CO2: Identify, formulate and solve the image formation and image modelling process.
- CO3: Analyze, evaluate and test existing practical computer vision systems.
- CO4: Implement the working of live computer vision system effectively.
- CO5: Apply theoretical and practical knowledge to identify the novelty and practicality of proposed computer vision methods.
- CO6: Design and develop practical and innovative computer vision applications or systems.
- CO7: Able to conduct real implication image processing and deep learning methods.
- CO8: Analyze and design algorithms for computer vision applications.

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Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1,PO2,PO4/ PSO4
CO3	PO1,PO2,PO5/ PSO1,PSO3
CO4	PO3,PO4,PO5/ PSO4
CO5	PO3,PO4,PO5,PO6/ PSO1,POS4
CO6	PO3,PO4,PO5,PO6/ PSO1,POS4
CO7	PO1,PO4 / PSO4
CO8	PO2,PO3,PO4,PO6 / PSO3,PSO4

MCSE0002: WIRELESS SENSOR NETWORKS

Objective: *To make students understand the protocols, algorithms and tools needed to support the deployment and functionality of wireless sensor networks.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Applications and Design Model:** Examples of available sensor nodes, Sample sensor networks applications, Design challenges, Contemporary network architectures, Operational and computational models, Performance metrics, Software and hardware setups. **Network Bootstrapping:** Sensor deployment mechanisms, Issues of coverage, Node discovery protocols **Physical and Link layers:** Radio energy consumption model, Power Management, Medium access arbitration: Low duty cycle protocols and wakeup concepts, Contention-based protocols, Schedule-based protocols, Optimization mechanisms **Localization and Positioning:** Properties of positioning, Possible approaches, Mathematical basics for the alteration problem, Single-hop localization, Positioning in multi-hop environments, Impact of anchor placement.	26
II	**Topology control:** Motivation and basic ideas, Flat network topologies, Hierarchical networks by dominating sets, Hierarchical networks by clustering, Combining hierarchical topologies and power control, Adaptive node activity. **Naming and Addressing:** Address and name management in wireless sensor networks, Assignment of MAC addresses, Distributed assignment of locally unique addresses, Content-based and geographic addressing. **Routing protocols:** The many faces of forwarding and routing, Gossiping and agent-based unicast forwarding, Energy-efficient unicast, Broadcast and multicast, Geographic routing, Coping with energy constraints, Mobile nodes. **Data-centric and content-based networking:** Introduction, Data-centric routing, Data aggregation, Data-centric storage. **Dependability Issues:** Security challenges, Threat and attack models, Quality of service provisioning, Time Synchronization: Introduction to the time synchronization problem, Protocols based on sender/receiver synchronization, Protocols based on receiver/receiver synchronization, Supporting fault tolerant operation.	26

References:

- Dorothea Wagner and Roger Wattenhofer , "Algorithms for Sensor and Ad Hoc Networks, Advanced Lectures", Lecture Notes in Computer Science 4621, 2007.
- Waltenegus Dargie, Christian Poellabauer , "Fundamentals of Wireless Sensor Networks: Theory and Practice", John Wiley & Sons , 2010.
- Carlos De Morais Cordeiro, Dharma Prakash Agrawal , "Ad Hoc and Sensor Networks: Theory and Applications", World Scientific, 2011.
- Holger Karl, Andreas Willig , "Protocols and Architectures for Wireless Sensor Networks", Wiley Publications, 2005.
- Cauligi S. Raghavendra, Krishna Sivalingam, Taieb M. Znati ,"Wireless Sensor Networks", Springer, 2005.

Focus: This Course focuses on Employability under CO1,CO2,CO8.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of wireless sensor networks, sensing, computing and communication tasks
- CO2: Understand the Sensor management, sensor network middleware, operating systems.
- CO3: Analyze the assess coverage and conduct node deployment planning,
- CO4: Devise appropriate data dissemination protocols and model links cost,

- CO5: Determine suitable medium access protocols and radio hardware.
- CO6: Understand the architectures, features, and performance for wireless sensor network systems and platforms
- CO7: Identify quality of service, fault-tolerance, security and other dependability requirements and conduct trade-off analysis between performance and resources.
- CO8: Evaluate the performance of sensor networks and identify bottlenecks.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO7 /PSO1
CO2	PO1, PO4/PSO2, PSO3
CO3	PO1, PO2, PO4/PSO3, PSO4
CO4	PO1/PSO2
CO5	PO2, PO3/PSO4
CO6	PO1/PSO3
CO7	PO1, PO3/PSO3, PSO4
CO8	PO1, PO7/PSO3

MCSE0003: SOFTWARE AND SERVICE ORIENTED ARCHITECTURE

Objective: *To understand basic concepts, theories, and techniques used in service-oriented architecture, along with governance strategies and trends in SOA.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Software Architecture – Types of IT Architecture, SOA Evolution, Key components, perspective of SOA, Enterprise-wide SOAArchitecture, Enterprise Applications, Solution Architecture for enterprise application Software platforms for enterprise Applications, Patterns for SOA, SOA programming models. Service-oriented Analysis and Design – Design of Activity, Data, Client and business process services. Technologies of SOA – SOAP, WSDL. Service integration with ESB	26
II	Web Services and Contemporary SOA- Message exchange patterns, Service activity, coordination. Atomic transactions, Business activities, Orchestration and Choreography- Issues Introduction to XML – Overview and Security. Introduction to Web Services and Security, SOA implementation and Governance strategy , trends in SOA, event-driven architecture, software as a service. SOA Delivery Strategies- SOA delivery lifecycle phases. Transaction processing – paradigm, protocols and coordination, transaction specifications, SOA in mobile, research issues in SOA	26

References:

- Shankar Kambhampaly ,"Service –Oriented Architecture for Enterprise Applications", Wiley India Pvt. Ltd, 2008.
- Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", PearsonEducation.
- Mark O' Neill, et al , "Web Services Security",Tata McGraw-Hill Edition, 2003.
- Thomas Erl , " Service-Oriented Architecture: Concepts, Technology & Design", Pearson Education Pvt. Ltd, 2008.
- Thomas Erl ,"SOA Principles of Service Design", Pearson Exclusives, 2007.
- Thomas Erl and Grady Booch, "SOA Design Patterns", Prentice Hall, 2008.

Focus: This Course focuses on Employability under CO1,CO2,CO7,CO8

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand primary concepts of SOA
- CO2: Design the software Platforms using SOA
- CO3: Understand Web Services and Contemporary SOA
- CO4: Understand Security issues of SOA
- CO5: Implement XML in designing SOA
- CO6: Know the integration of SOA technological points with Web Services.
- CO7: Implement SOA in development cycle of Web Services
- CO8: Implement SOA in Transaction Processing

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO3/PSO2
CO3	PO1/PSO1
CO4	PO1/PSO1
CO5	PO5/ PSO4
CO6	PO5/PSO4
CO7	PO5/PSO4
CO8	PO5/PSO4

MCSE0004: PATTERN RECOGNITION

Objective: *Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test. **Statistical Patten Recognition:** Bayesian Decision Theory, Classifiers, Normal density and discriminant functions,	26
II	**Parameter estimation methods:** Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models. **Nonparametric Techniques:** Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification. **Unsupervised Learning & Clustering:** Criterion functions for clustering, Clustering Techniques: Iterative square - error partitional clustering – K means, agglomerative hierarchical clustering, Cluster validation.	26

References:

- Richard O. Duda, Peter E. Hart and David G. Stork ,"Pattern Classification", 2nd Edition, John Wiley, 2006.
- C. M. Bishop ,"Pattern Recognition and Machine Learning", Springer, 2009.
- S. Theodoridis and K. Koutroumbas ,"Pattern Recognition", 4th Edition, Academic Press, 2009.

Focus: This Course focuses on Employability under CO1,CO4,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand a variety of pattern recognition algorithms, along with pointers on which algorithms work best under what conditions, so that students can make sound decisions on what approaches to take when faced with a real world problem.
- CO2: Understanding the various applications Pattern Recognition in real life applications.
- CO3 Formulate PR models based different classifiers.
- CO4: Apply the Statistical Patten Recognition methods for improving classification
- CO5: Identifying the parameter estimation methods for feature extraction.
- CO6:Analyze the non-parameter Techniques for Pattern classification.
- CO7:Design model based on Machine Learning to Pattern Classification.
- CO8:Analyze the use of Unsupervised Learning for pattern clustering.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO7 /PSO1
CO2	PO1, PO3,PO4/PSO2, PSO3

CO3	PO1, PO2, PO4/PSO3, PSO4
CO4	PO1, PO5/PSO2
CO5	PO2, PO3/PSO4
CO6	PO1,PO2/PSO3
CO7	PO1,PO2, PO3/PSO3, PSO4
CO8	PO1, PO7/PSO3

MSE0005: HIGH PERFORMANCE COMPUTING

Objective: *This subject introduces students to the essential tools and techniques of high performance computing. The main objectives are to introduce students to different frameworks of parallel and distributed computing that they can use in their specific areas of interest. The students may learn to program multi-core processors as well as clusters of personal computers using the widely used computer languages.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Overview of Parallel Techniques:** Classification of Instruction Set Architectures, Instruction level, Thread level and Process level. **Pipelining**: Instruction and functional pipelines, Hazards in a pipeline, Branch prediction techniques; Superscalar Techniques. **Memory Hierarchies:** Basic hierarchical memory concepts,Cachedesign, Virtual memory design &uses, Memory hierarchy performance. **Parallel Programming Concepts:** Abstract Machine Models – RAM& PRAM, various parallel algorithms on them. **Introduction:** Cloud Computing, Computing Platforms and Developments, Virtualization.	26
II	**Cloud Computing Architecture:** Reference Model, Types of Cloud, Concurrent Computing, High Throughput Computing. **Cloud Applications:**Application in Industry, General Cloud Applications, Advanced Topics in Cloud Computing. **Introduction**: Definition of Grid Computing, Grid Architecture Standard for Grid, Data Management in Grid, Grid Scheduling **Grid Security & Middleware:** Trust and Security in Grid, Grid Middle ware, Architectural Overview of Grid Projects. **Grid Computing Methods:** Monte Carlo Method, Partial Differential Equations, Some Grid Tool- Globus, glite.	26

References:

- John L Hennessy & David A, “Patterson-Computer Architecture: A Quantitative Approach”, Morgan Kaufmann, 2011.
- Kai Hwang ,“Advanced Computer Architecture”, Tata McGraw Hill Edition, 2013.
- Rajkumar Buyya, Christian Vecchiola & S, Thamarai Selvi ‘ “ Mastering Cloud Computing”, Tata McGraw Hill Edition, 2013.
- Fredric Magoules, Jie Pan, Kiat-An Tan & Abhinit Kumar , “Introduction to Grid Computing”, CRC Press, Taylor & Francis Group, 2007.

Focus: This Course focuses on Employability under CO2,CO4,CO7.

Outcome: At the end of this course the students will be able to:

- CO1:Understand architecture of computing technology.
- CO2: Design, formulate and implement high performance versions single threaded algorithms
- CO3: Demonstrate the architectural features of High performance computers
- CO4: Design programs to extract maximum performance in a multicore, shared memory execution environment processor.
- CO5: Design and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm.
- CO6: Administration, scheduling, code portability and data management in an HPC environment.
- CO7: Analyze the suitability of different HPC solutions to problems found in Computational Science.
- CO8: Implement parallel programs on different hardware architectures and software environments.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2/ PSO1
CO2	PO1,PO3,PO4/ PSO2
CO3	PO1,PO2,PO4/ PSO1
CO4	PO1,PO4,PO5,PO6/ PSO2,PSO4
CO5	PO1,PO3,PO5/ PSO2
CO6	PO1,PO2,PO5/ PSO1
CO7	PO1,PO4,PO6/ PSO1,PSO4
CO8	PO2,PO3,PO4/ PSO1,PSO2

MCSE0006: WEB MINING

Objective: *Introduce students to the basic concepts and techniques Web Mining for extracting knowledge from the web.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Concepts of Web Mining, Classification of Web Mining: Web Content Mining, Web Structure Mining, Web Usage Mining, Issues in Web Mining, Crawling the Web, Hyperlink Analysis, Basics of HTML, HTTP, HTTPS and scripting. **Web Content Mining:** document indexing and retrieval in the web environment, web documents categorization and clustering, Text and Web Page Pre-Processing. **Web Structure Mining:** Anchor Text,Hyperlink Analysis, Static and Dynamic Hyperlinks, Web Graph, Web Search, Query Expansion, Primary web browsing (crawling), Link topology analysis.	26
II	**Social Network Analysis:** Social Sciences and Bibliometry, Prestige, Centrality, Co- citation, PageRank and HITS, Stochastic HITS and Other Variants, Enhanced Models and Techniques, Avoiding Two- Party Nepotism, Outlier Elimination, Exploiting Anchor Text. **Evaluation of Topic Distillation**: HITS Algorithm. **Web Usage Mining Process and Techniques:** Data collection and Pre Processing, Data modeling for web usage mining, Discovery and analysis of web usage patterns, Session and visitor analysis, Cluster analysis and visitor segmentation. **Resource Discovery:**Collecting important pages preferentially, crawling as guided search in a graph, Keyword-Based graph search, Similarity search using Link Topology. **The Future Of Web Mining:** Natural Language Processing, Lexical Networks and Ontologies, Part- of- Speech and Sense Tagging, Parsing and Knowledge Representation, Profiles, Personalization, Collaboration, Opinion mining.	26

References:

- Soumen Chakrabarti, "Mining the Web: discovering knowledge from hypertext data, Part 2", Morgan Kaufmann Publisher, 2010.
- Bing Liu ,"Web Data Mining: exploring hyperlinks, contents, and usage data", Springer, 2007.
- Gordon Linoff and Michael Berry ,"Mining the Web: Transforming Customer Data into Customer Value", John Wiley & Sons , 2002.
- C. Manning, P. Raghavan, and H. Schütze ,"Introduction to Information Retrieval", Cambridge University Press, 2008.
- Ricardo Baeza-Yate, Berthier Ribeiro-Neto, ,"Modern Information Retrieval", Second Edition, Addison Wesly, 2011.

Focus: This Course focuses on Employability under CO2,CO4,CO5,CO7.

Outcome: At the end of this course the students will be able to:

- CO1: Understand the fundamentals of Web Mining Principles for effective web information retrieval
- CO2: Understand the functionality of the various web mining components for knowledge discovery.

- CO3: Compare and evaluate different web mining techniques for structured, unstructured and semi structured data.
- CO4:Extract knowledge using web mining techniques for computing rank of the retrieved results.
- CO5:Acquire statistical techniques to analyze complex information from the content, structure and usages of the web application.
- CO6:Acquire statistical techniques to analyze complex information and social networks;
- CO7:Learn to critically read and connect a significant amount of scientific literature;Apply technical and analytic skills to develop a significant research project.
- CO8:Describe key concepts such as deep web, surface web, semantic web, web log, hypertext, social network, and evaluation measures such as precision and recall.
- CO9: Analyze and explain what web mining problems are satisfiably solved, what is worked upon at the research frontier and what still lies beyond the current state-of-the-art.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 ,PO4/ PSO3
CO2	PO1,PO2,PO6/PSO4
CO3	PO2,PO3/PSO4
CO4	PO1,PO3/PS1,PS2
CO5	PO1, PO2/PS2,PS3
CO6	PO1,PO2,PO3/PS2,PS3
CO7	PO1,PO3/PS1,PS3
CO8	PO2,PO3/PS1,PS2,PS3
CO9	PO1,PO2,PO3/PSO2,PSO4

MCSE0007: MACHINE LEARNING

Objective: *Introduce students to the basic concepts and techniques Web Mining for extracting knowledge from the web.*

Credits: 04 **Semester III** **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Definition, Applications, Types of learning system **Inductive Classification**: Concept learning, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, finding maximally specific hypotheses, Find-S algorithm, Version spaces and the candidate elimination algorithm, inductive bias. **Evaluation of Learning Algorithms:** Measuring the accuracy of learned hypotheses, cross-validation, learning curves, **Supervised learning:** Linear Regression, Gradient Descent (GD), Classification-Logistic regression, k-nearest neighbor classifier **Decision Tree Learning:** Picking the best splitting attribute: entropy and information gain,ID3 Algorithm, Searching for simple trees and computational complexity, Overfitting, Decision tree classifier,	26
II	**Supervised Learning:**Feature Selection, Feature Extraction, Collaborative Filtering, Support vector machine classifier, Naïve Bayes classifier **Unsupervised Learning:** k-means clustering, Hierarchical clustering **Ensemble Methods:** Bagging, Boosting, Improving classification with Ada-Boost algorithm. **Deep Learning/ Artificial Neural Network:** Introduction, Model Representation, Gradient Descent, Stochastic Gradient Descent, Multilayer Perceptron, Multiclass Representation, Backpropagation Algorithm.	26

Text Book:

- Tom M. Mitchell , "Machine Learning. Tata McGraw-Hill Education, 2013.
- Alpaydin, E. ' "Introduction to machine learning. MIT press, 2009.

Reference Books:

- Harrington, P. ' "Machine learning in action. Shelter Island, NY: Manning Publications Co, 2012.
- Bishop, C. M. ' "Pattern recognition and machine learning (information science and statistics) springer-verlag new york. Inc. Secaucus, NJ, USA, 2006.

Focus: This Course focuses on Employability under CO1,CO2,CO6,CO8.

Outcome: After completion of Lab, student will be able to:

- CO1: Apply the basic concepts of machine learning.
- CO2: Formulate models based on regression.

- CO3: Design models based on supervise and re-enforcement learning for classification.
- CO4: Apply the ensemble methods for improving classification.
- CO5: Identify the ways of feature extraction, reduction and selection.
- CO6: Analyze the use of machine learning algorithms.
- CO7: Analyze and formulate a model based on CNN.
- CO8: Design application based on machine learning.

Mapping of Course Outcome (COs) with Program Outcome (POs) and Program Specific Outcome (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 / PSO3
CO2	PO2 / PSO3
CO3	PO1, PO3/PSO3
CO4	PO1, PO2/ PSO1, PSO3
CO5	PO2/ PSO3
CO6	PO2/ PSO1 , PSO3
CO7	PO2, PO3/ PSO1, PSO3
CO8	PO3/PSO4

COURSE STRUCTURE

B.TECH.

COMPUTER SCIENCE & ENGINEERING

Specialization

in

Industrial Internet of Things (IIoT)

Under

Choice Based Credit System (CBCS)

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Program Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals, researchers or entrepreneurs, for developing sustainable solutions.

PEO2: Attain positions of leadership in an organization and /or on teams.

PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Program Specific Outcomes (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.

PSO2: Design and develop hardware and software interfaces along with latest tools and technology to meet the needs of industry.

PSO3: Analyze the algorithmic principles, theory of computation and mathematical foundations for the modeling and design of computing systems.

PSO4: Apply knowledge to provide innovative solutions to existing problems and identify research gaps.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics and science, with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE.

PO2: Problem Analysis: Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of solutions: Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations.

PO4: Conduct Investigations of Complex problems: Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development

PO8: Ethics: Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

PO12: Life-Long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change.

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BPHS0001	Engineering Physics	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication – I	2	0	0	2	2
4.	BECG0001	Electronics Engineering	3	1	0	4	4
5.	BCSG0001	Python Programming	4	1	0	5	5
6.	BCSG0900	Introduction to IoT	4	0	0	4	5
PRACTICALS							
7.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
8.	BELH0801	English Language Lab – I	0	0	2	1	2
9.	BECG0800	Electronics Lab I	0	0	2	1	2
10.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
11.	BCSG0800	Python Programming Lab	0	0	2	1	2
		TOTAL	**19**	**4**	**10**	**28**	**34**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BEEG0001	Electrical Engineering	3	1	0	4	4
3.	BELH0002	English Language Skills for Communication – II	2	0	0	2	2
4.	BCSG0901	IIOT Communication & Interface	4	0	0	4	5
5.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
6.	BCSC 1001	Computer Programming	3	0	0	3	4
PRACTICALS							
7.	BCSC 0800	C PROGRAMMING Lab	0	0	2	1	2
8.	BELH0802	English Language Lab – II	0	0	2	1	2
9.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
10.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1	2
		TOTAL	**18**	**3**	**8**	**25**	**31**

Mechanical Engineering

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication – I	2	0	0	2	2
4.	BECG0001	Electronics Engineering	3	1	0	4	4
5.	BMEG0900	Product Design & Development	5	0	0	5	5
PRACTICALS							
7.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1	2
8.	BELH0801	English Language Lab – I	0	0	2	1	2
9.	BECG0800	Electronics Lab I	0	0	2	1	2
10.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**23**	**31**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BEEG0001	Electrical Engineering	3	1	0	4	4
3.	BELH0002	English Language Skills for Communication – II	2	0	0	2	2
4.	BMEG0901	Product Design Manufacturing	4	0	0	4	5
5.	BPHS0001	Engineering Physics	3	1	0	4	4
6.		C Programming	3	0	0	3	3
7.		Applied Mechanics	3	0	0	3	3
PRACTICALS							
7.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
8.	BELH0802	English Language Lab – II	0	0	2	1	2
9.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
10.		C Programming/Python Lab	0	0	2	1	2
11.		Mechanics Lab	0	0	2	1	2
		TOTAL	**17**	**3**	**10**	**29**	**35**

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			THEORY						
1.	BCSC1001	Computer Programming	3	1	0	0	4	4	
2.	BCSC0002	Object Oriented Programming	3	0	0	0	3	3	Computer Programming
3.	BCSC0003	Database Management System	3	0	0	0	3	3	
4.	BCSC0004	Operating Systems	3	0	0	0	3	3	
5.	BCSC0005	Computer Organization	3	0	0	0	3	3	
6.	BCSC0006	Data Structures & Algorithms	3	1	0	0	4	4	Computer Programming
7.	BCSC0007	Introduction to Microprocessors	3	0	0	0	3	3	Computer Organization
8.	BCSC0008	Computer Networks	3	1	0	0	4	4	
9.	BCSC0009	Software Engineering	3	0	0	0	3	3	
10.	BCSC0010	Discrete Mathematics	3	1	0	0	4	4	
11.	BCSC0011	Theory of Automata & Formal Language	3	1	0	0	4	4	
12.	BCSC0012	Design and Analysis of Algorithm	3	1	0	0	4	4	Data Structures & Algorithms
13.	BCSC0600	Introduction to Open Source Software & Open Standards	2	0	0	0	2	2	
14.	BCSC0601	Web Programming through PHP	3	0	0	0	3	3	Computer Programming
15.	BCSC0014	Applied Database Management System	4	0	0	0	4	4	
			PRACTICALS						
1.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
2.	BCSC0801	Object Oriented Programming Lab	0	0	2	0	1	2	Programming Lab
3,	BCSC0802	Database Management System Lab	0	0	2	0	1	2	
4.	BCSC0803	Operating Systems Lab	0	0	2	0	1	2	
5.	BCSC0804	Computer Organization Lab	0	0	2	0	1	2	
6.	BCSC0805	Data Structures & Algorithms Lab	0	0	2	0	1	2	Programming Lab
7.	BCSC0806	Microprocessors Lab	0	0	2	0	1	2	Computer Organization Lab
8.	BCSC807	Design and Analysis of Algorithms	0	0	2	0	1	2	
9.	BCSC0900	Web Programming Lab	0	0	2	0	1	2	Programming Lab
10.	BCSC0808	Applied Database Management System	0	0	2	0	1	2	
		Total	**45**	**6**	**20**	**0**	**61**	**71**	

Program Elective (Only for Specialization Programme)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
Bouquet: Industrial Internet of Things (IIoT)									
THEORY									
1.	BCSE0902	Smart Industrial Connectivity	4	0	0	0	4	4	
2.	BCSE0903	Data Science And Analytics	4	0	0	0	4	4	
3.	BCSE0904	Machine Learning	4	0	0	0	4	4	
4.	BCSE0905	Artificial Intelligence	4	0	0	0	4	4	
		TOTAL	**16**	**0**	**0**	**0**	**16**	**16**	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BCSJ0950	Mini Project – I	0	0	0	0	2	0	
2.	BCSJ0951	Mini Project – II	0	0	0	0	2	0	
3.	BCSJ0971	Project – Part I	0	0	0	0	3	0	
4.	BCSJ0972	Project – Part II	0	0	0	0	8	0	
5.	BCSJ0991	Industrial Training	0	0	0	0	2	0	
		TOTAL	**0**	**0**	**0**	**0**	**17**	**0**	

Mandatory Non Graded Course

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
		TOTAL	**8**	**0**	**0**	**0**	**0**	**8**	

Humanities and Social Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purposes – I	2	0	0	0	2	2	
4.	BELH0004	English for Professional Purposes – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAH0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	8	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	8	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG0001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BCSG0001	Python Programming	4	1	0	0	5	5	
PRACTICALS									
5.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
6.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
7.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
8.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
9.	BCSG0800	Python Programming Lab	0	0	2	0	1	2	

BCSC1001: COMPUTER PROGRAMMING

Objective: *To impart adequate knowledge on the need of problem solving techniques and develop programming skills to implements applications using the concepts of C Language. Also by learning the programming constructs they can easily switch over to any other language in future.*

Credits:04 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Generation of Programming Languages:** Low, Assembly, High and 4GL. **Language Processors:** Compiler, Interpreter, Assembler, Linker and Loader. **Algorithm:** Introduction, Features, Different Ways of stating Algorithms. **Flow Chart:** Introduction, Standard, Guidelines, Advantages and Limitations of using Flowcharts. **Basics of C:** Overview, Structure of a C program, Identifier, Keywords, Variables, Data types, Formatted Input and output. **Operators and Expression:** Assignment, Unary, Arithmetic, Relational, Logical, Bitwise, Conditional, Special operators and their precedence & Associativity. IEEE representation of data types like float & double, Lvalue and Rvalue **Type Conversion:** Type Promotion in expression, Conversion by Assignment, Truncation and Casting Arithmetic expression. **Decision and Case Control Structure:** if, if-else, nested if-else, Decisions using switch, switch versus if-else ladder, goto. **Loop Control Structure:** For loop, while loop, do-while loop, nesting of loops, break, and continue. **Arrays:** Introduction, one-dimensional and two-dimensional Array-Declaration, Initialization, Address Calculation. **Operations on Arrays:** Insertion, Deletion, Linear Search & Bubble Sort. **String:** Introduction, One dimensional and two dimensional Array-Declarations, Initialization **Operations on String:** Length, Copy, Reverse, Concatenate, Compare with & without built-in functions.	25
II	**Functions:** Declaration and Definition, Category of Functions, Parameter Passing Techniques – Call by Value, Passing Arrays to Functions. **Introduction to Storage Classes:** Auto, Static, Extern and Register. **Recursion:** Mechanics of Recursive Call, Implementation of Recursion, Recursion vs. Iteration. **The C Preprocessor:** Introduction, Macro Expansion and File Inclusion, Conditional Compilation and Miscellaneous Directives. **Pointers:** Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Arrays and Pointers, Pointer and Strings, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointer to an Array, Two Dimensional Array and Pointers, Pointers to Functions, Dynamic Memory Allocation, void Pointer and Null Pointer. **User Defined Types:** enum, typedef, Union and Structure - Declaration, Initialization, Nested Structures, Arrays of Structures, Structure and Pointer, Passing Structure Through Function. Difference between Structures and Union. **File Handling:** Data and Information, File Concepts, File Organization, File Operations: Open, Read, and Close, Trouble in Opening a File. File Opening Modes, Working with Text Files. Random Access to Files of Records. Introduction to Command Line Arguments.	25

Text Books:

- Behrouz A. Forouzan and Richard F. Gilberg, “Computer Science – A Structured Programming Approach Using C”, C Language Learning, 2007

Reference Books:

- Herbert Schildt, “C: The Complete Reference”, 5th Edition, McGraw Hill Education
- K. N. King, “C Programming a Modern Approach”, W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, “The C Programming Language”, PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, “Programming in C”, Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO4.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of problem solving skills.
- CO2: Apply the basic principles of programming in C language.
- CO3: Understand the concepts of arrays and strings in C language.
- CO4: Apply the concepts of functions to solve real world problems.
- CO5: Illustrate the concepts of recursion.
- CO6: Understand the concepts of pointers in C language.
- CO7: Understand the basic concepts of file handling.
- CO8: Develop algorithmic solutions to simple computational problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO10/PSO1,PSO3
CO3	PO1,PO2,PO3,PO4/PSO1,PSO3
CO4	PO1,PO3, PO12/PSO1,PSO2
CO5	PO1,PO2,PO4 /PSO1,PSO3
CO6	PO1,PO2,PO3,PO4/PSO1,PSO2
CO7	PO1,PO3,PO6 /PSO1
CO8	PO1,PO2,PO4,PO10,PO12/PSO1,PSO3

BCSC0002: OBJECT ORIENTED PROGRAMMING

OBJECTIVE: *This course introduces the Object-Oriented programming paradigm to students. It also teaches a student how to think objectively and model a Java program for solving real-world problems.*

CREDITS: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Object-Oriented Programming:** Features of Object-Oriented Programming, Introduction to Object-Oriented Java Programming. **g Java Technology & Environment:** Understanding the compilation process of the JVM, JVM vs JDK vs JRE, Key Features of Java, Structure of a simple Java program. **Working with Java Primitive Data Types:** Strongly Typed nature of Java, Primitive Data Types in Java, The new 'var' keyword, Scope of a variable. **Accepting User Input in Java Programs:** using the Scanner class, using command line arguments. **Programming Constructs:** Sequence, Selection, Iteration & Transfer Statements, For-Each Loop. **Working with Java Arrays**: Declaring and Initializing One-Dimensional and Two-Dimensional Arrays in Java, Introduction to java. util. Arrays class. **The String API:** String Data Type, commonly used methods from the String API, StringTokenizer, StringBuilder & StringBuffer. **Creating and Using Methods:** Signature of a method, Types of Methods, Overloading methods in a class, Static and Non-Static Methods. **Describing and Using Objects & Classes:** Declare the structure of a Java class, declaring members of a class (fields and methods), declaring and using Java Objects, lifecycle of an Object (creation, assignment, dereferencing and garbage collection), Constructors of a class, Overloading Constructors, Constructor chaining using 'this' and 'super' keyword. **Using Java Packages:** create and import Java packages and static imports, abstracting program logic to packages, creating executable main class, running the executable class inside a package. **Applying Encapsulation**: Using access modifiers with/in a class, principles of encapsulation. **Programming Abstractly Through Interfaces:** create and implement Interfaces for programs, private and default methods in Interfaces, declaring Abstract Classes, Constructors in Abstract Classes. Marker Interface, Functional Interfaces, Lambda Expressions in Java.	20
II	**Reusing Implementations using Inheritance:** Declaring Subclasses and Superclasses, extend Abstract Classes, implementing Interfaces, exploring polymorphic behaviour by overriding methods, Object Types vs Reference Types, differentiate overloading, overriding and hiding. **Exception Handling:** Exception Hierarchy, Need of Exception Handling, Checked Exceptions, Unchecked Exceptions and Errors, Try-Catch Blocks, Finally, Throw & Throws Keywords, creating and handling Custom Exceptions. **Threads in Java:** Life Cycle of a Thread, creating threads using Runnable and Thread, 'sleep ()', Thread Priorities. **Using Wrapper Classes:** Wrapper Classes in Java, Boxing-Unboxing-Auto Boxing-Auto Unboxing. **Generics & Collections:** Creating Generic classes, Generic Methods, Diamond Notation, Wildcards, Type Erasure, Collection Hierarchy, Base Interfaces, Lists, Sets and Maps. **The Stream API:** Introduction to the Stream API, using lambda expressions in Streams. **Regular Expressions:** Pattern and Matcher Class.	18

	JDBC: JDBC Drivers, Connecting to a MySQL Database, Driver Manager, Connection Interface, Statement Interface, Result Set Interface, Prepared Statements.	

Text Book:

- Herbert Schildt , "The Complete Reference, Java Eleventh Edition", Oracle Press. 2019.

Reference Book:

- Cay S Hosrtmann , "Core Java Volume I—Fundamentals, Eleventh Edition", Pearson, 2018.
- Rogers Cadenhead , "Sams Teach Yourself Java in 21 Days (Covers Java 11/12), 8th Edition", Pearson, 2020.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of the course, students will be able to -

- CO1: Understand the basics of Object-Oriented Programming paradigm.
- CO2: Construct the logical flow of programs by using the sequence, selection, iterations and transfer statements.
- CO3: Apply the concepts of Object- Oriented Programming to model programs in Classes, Abstract Classes, Interfaces and Enums, and simplify program function by dissecting it into methods.
- CO4: Understand accessibility of members in a program unit and create packages to prevent namespace collisions.
- CO5: Predict run-time errors in a program by examining program functioning.
- CO6: Show the parallel processing capabilities of a program using a multithreading concept.
- CO7: Experiment with the predefined classes and interfaces defined in the Collections Framework.
- CO8: Develop a program using JDBC connectivity to demonstrate data persistence.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1 /PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/ PSO2
CO7	PO1,PO2,PO11/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO2

BCSC0003: DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database & NoSQL system. Students learn how to design and create a good database.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	Introduction: An Overview of Database Management System, Database System Vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with Case Studies. Data Modeling Using the Entity-Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. Relational Data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization I:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, Non-Redundant Cover, Canonical Cover **PL/SQL:** Query languages, nested queries, group by and having clause.	20
II	**Database Design & Normalization II:** 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, MVD and JDs, Inclusion Dependence. **File Organization:** Indexing, Structure of Index files and Types, Dense and Sparse Indexing **Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication.	20

Text Books:

- Elmasri and Navathe , “Fundamentals of Database Systems”, 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler ,“NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.

References Books:

- Date C J, ”An Introduction to Database Systems”, 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , “Database Concepts”, 5th Edition, TMH, 1998.

- Redmond, E. & Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO6.

Outcome: After the completion of the course, the student will:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss indexing mechanisms for efficient retrieval of information from a database.
- CO8: Discuss recovery system and be familiar with introduction to web database, distributed databases.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1 /PSO1
CO2	PO2, PO3/ PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3,PO9/ PSO2
CO7	PO1,PO11 /PSO1
CO8	PO1,PO3,PO12/ PSO2

BCSC0004: OPERATING SYSTEMS

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Operating System and its Classification - Batch, Interactive, Multiprogramming, Time sharing, Real Time System, Multiprocessor Systems, Multithreaded Systems, System Protection, System Calls, Reentrant Kernels, Operating System Structure- Layered structure, Monolithic and Microkernel Systems, Operating System Components, Operating System Functions and Services. **Processes:** Process Concept, Process States, Process State Transition Diagram, Process Control Block (PCB), Process Scheduling Concepts, Threads and their management. **Process Synchronization:** Principle of Concurrency, Implementation of concurrency through fork/join and parbegin/parend, Inter Process Communication models, shared memory and message passing Schemes, Producer / Consumer Problem, Critical Section Problem, race condition ,two process software solution Dekker's solution, Peterson's solution, Semaphores, Synchronization Hardware. **Classical Problem in Concurrency:** Dining Philosopher Problem, Readers Writers Problem, sleeping barbar,	20
II	**Deadlock:** System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock, Combined Approach. **Memory Management:** Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation. **Virtual memory concepts:** Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Locality of reference. **I/O Management and Disk Scheduling:** I/O devices, I/O subsystems, I/O buffering, Disk storage and disk scheduling. **File System:** File concept, File organization and access mechanism, File directories, File allocation methods, Free space management.	20

Text Books:

- Silberschatz, Galvin and Gagne , "Operating Systems Concepts",9th Edition, Wiley, 2012.

Reference Books:

- Sibsankar Halder and Alex a Aravind , "Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel ,"An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the classification of operating system environment.
- CO2: Understand the basic of process management.
- CO3: Apply the concept of CPU process scheduling for the given scenarios.
- CO4: Illustrate the process synchronization and concurrency process in operating system.
- CO5: Analyze the occurrence of deadlock in operating system.
- CO6: Describe and analyze the memory management and its allocation policies.
- CO7: Understand the concepts of disk scheduling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO4/PSO1,POS3
CO4	PO3,PO4,PO6/PSO3,PSO4
CO5	PO1,PO4/PSO1,PSO3
CO6	PO1,PO2 /PSO1,PSO3
CO7	PO1,PO2,PO7/PSO1,PSO3

BCSC0005: COMPUTER ORGANIZATION

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**PREAMBLE:** Subject Introduction, Basic organization of the computer and block level description of the functional units, Number Representation, Fixed and floating-point Number Representation-Arithmetic Addition/subtraction, overflow, IEEE standard for floating point representation, **Basic Computer Organization and Design:** Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description. Introduction to combinational circuit - Half Adder, Full Adder, carry look ahead adder, Multiplexor/ De multiplexer and Decoder/Encoder, Introduction to sequential circuit- Flip-Flops, Synchronous and Asynchronous Counters, Register, Bus and memory Transfer Language. **Arithmetic Operations:** Addition and subtraction of signed numbers, Hardware implementation of Method, Multiplication: Signed operand multiplication, Booths algorithm, Hardware implementation of Algorithms, Array Multiplier. **Processor Organization:** General register organization, Single Accumulator and Stack organization, Addressing Modes, Types of Computer Instructions – one, two, three & four address, Instruction Cycle, Instruction Formats.	20

II	**Micro-operations:** Arithmetic, Logical & Shift Micro operations with some applications. **Multiprogramming and Multiprocessing:** Introduction to pipelined operation. **Hardwired & Microprogrammed Unit:** Execution of a complete instruction & Branch Instructions, Hardwired control Unit, Micro programmed control Unit, Micro-Instructions, Microinstruction with Next Address field, Pre-Fetching Microinstructions, Concept of Horizontal and Vertical Microprogramming. **Memory:** Basic concept and Hierarchy, RAM memories, 2D, 2 & 1/2D Memory Organization, ROM Memories, Cache Memories: Concept and Design issues performance, Address mapping and Replacement, Auxiliary memories: Magnetic disk, Magnetic tape and Optical disks, Virtual memory: Concept and Implementation. Input/Output: Peripheral Devices, I/O interface, I/O ports. **Interrupts:** Interrupt hardware, Types of Interrupts and Exceptions, Buses, Bus architecture, Types of Buses and Bus Arbitration. Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O, Direct Memory Access, I/O channels and Processors, Standard communication interfaces.	**20**

Text Books:

- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4th**Edition**, Elsevier Publication, 2008.
- William Stalling , "Computer Organization",8th Edition, PHI, 2011.
- V. CarlHamacher, Zaky , "Computer Organization",4th International Edition, TMH, 1996.
- John P Hays, "Computer Organization", 2nd Edition, TMH.
- Tannenbaum , "Structured Computer Organization", 5thEdition, PHI, 2005.
- P Pal Chaudhry , "Computer Organization & Design", 2ndEdition, PHI, 2002.

Focus: This Course focuses on Employability under CO1,CO2,CO3.CO7.

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the basics of digital computer system.
- CO2: Demonstrate the principle of arithmetic operations on unsigned, signed integers and floating point numbers.
- CO3: Understand the concepts of Combinational and Sequential circuits and their applications.
- CO4: Understand the CPU architecture and organization.
- CO5: Explain the basic concepts of pipelining.
- CO6: Design the steps for the execution of the complete instruction for hardwired and micro-programmed control unit.
- CO7: Explain the function of memory hierarchy.
- CO8: Determine the interface of CPU with input/output devices and their modes of transfer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO1,PO3/PSO1
CO3	PO2,PO3,PO5/PSO2
CO4	PO2,PO3,PO4/PSO1,PSO3
CO5	PO2,PO3,PO4/PSO2
CO6	PO1,PO2,PO3/PSO1,PSO3

CO7	PO2,PO3,PO5/PSO2,PSO3
CO8	PO3,PO4/PSO1

BCSC0006: DATA STRUCTURES AND ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs*.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Terminology, Elementary Data Organization, Properties of an Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic Notations – Big-Oh; Operations on Data Structure, Abstract Data Types (ADT). **Linked Lists:** Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Generalized Linked List, Polynomial Representation and Addition. **Stacks:** Primitive Stack Operations - Push & Pop, Array and Linked Implementation of Stack in C, Application of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of Infix to Postfix expression, Recursion, Principles of Recursion, Tail Recursion, Removal of Recursion, use of stack in Recursion, Tower of Hanoi Problem. **Queues:** Operations on Queue - Add, Delete operations, Implementation of Queue Using Array and Linked List, Circular Queues, Deque and Priority Queue. **Trees:** Basic Terminology, Array Representation and Dynamic Representation; Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Tree Traversal Algorithms - Inorder, Preorder and Postorder; Threaded Binary Trees, Traversing Threaded Binary Trees.	20
II	**Search Trees:** Binary Search Trees (BST), Insertion and Deletion in BST, AVL Trees, Introduction to M-Way Search Trees, B Trees. Threaded binary trees, Priority Queues –Definition and applications, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, and Deletion from a Max Heap. **Searching:** Sequential Search, Binary Search. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Two Way Merge Sort, and Heap Sort. **Graphs:** Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees – Prim's and Kruskal's Algorithm; Shortest Path Algorithm – Bellman-Ford and Dijkstra's Algorithm. **Hashing & Indexing:** Hash Function, Collision Resolution Strategies. Primary Indices, Secondary Indices, Indexing and Hashing Comparisons.	20

Text Book:

- Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein (), "*Data Structures Using C and C++*", 2nd Edition, PHI, 2009.

Reference Books:

- Horowitz and Sahani , "*Fundamentals of Data Structures*", 3rd Edition, W H Freeman & Co, 2004-05.
- Jean Paul Trembley and Paul G. Sorenson , "*An Introduction to Data Structures with Applications*", 2nd Edition, TMH, 2007.
- R. Kruse, "*Data Structures and Program Design in C*" , 2nd Edition, Pearson Education, 2004.
- Lipschutz Schaum's Outline Series , *"Data Structures"*, 12th Reprint, TMH, 2010.
- G A V Pai , "*Data Structures and Algorithms",* TMH, 2009.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO7.

Outcome: After completion of course, student will be able to:

- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2
CO3	PO1/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4/PSO3
CO6	PO2/PSO4
CO7	PO2/PSO4

BCSC0007: INTRODUCTION TO MICROPROCESSORS

Objective: *Objective of this subject is to introduce the basic concepts of microprocessor and assembly language programming. Identify and explain the operation of the components of typical microprocessor: the role of the ALU, registers, stack and the use of interrupts.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Microprocessors Evolution and Types, Basics of Pentium Microprocessor, Microprocessor Application, **8-Bit Microprocessor:**8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction Set - Data Transfer Operation, Arithmetic Operation, Logic Operations and Branch Operations; Introduction to Assembly Language Program. **Programming Technique with Additional Instruction**: Looping, Counting, Indexing, Additional Data Transfer and 16-Bit Arithmetic Instruction, Counters and Time Delays, Stack and Subroutine.	20
II	**16 Bit Microprocessor:** Architecture of 8086 – Register Organization, Execution Unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities. **Peripheral Interfacing:** I/O Programming, Programmed I/O, Interrupt Driven I/O, DMA I/O, Memory-Mapped I/Os. **Peripheral Devices:** 8237 DMA Controller, 8255 Programmable Peripheral Interface, 8253/8254 Programmable Timer/Counter, 8259 Programmable Interrupt Controller.	18

Text Books:

- N Senthil Kumar, M Saravanan, and S Jeevananthan , "Microprocessors and Microcontrollers", Oxford University Press India, 2010.

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- Ray A.K. Bhurchandi.K.M , "Advanced Microprocessor and Peripherals", TMH, 2002.
- D. V. Hall , "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.
- Y.C. Liu and G.A. Gibson , "Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design", 2nd Edition, PHI, 2003.

Focus: This Course focuses on Employability under CO1,CO4,CO7.

Outcome: After the completion of the course, the student will be able to:

- CO1: Demonstrate the Microprocessor internal architecture and its operations.
- CO2: Develop programs based on 8085 microprocessor instruction set and addressing mode.
- CO3: Develop program using looping, counting, indexing, counter and time delays.
- CO4: Understand the concept of stack and subroutine for modular approach.
- CO5: Compare accepted standards and guidelines to select microprocessor (8085 & 8086) to meet performance requirements.
- CO6: Analyze the concept of interfacing the processor to external device with I/O programming & Interrupt Driven I/O.
- CO7: Understand the working of interfacing chips (8237, 8253/54, 8255 & 8259).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1,PSO2
CO3	PO2,PO3/PSO1,PSO2
CO4	PO1,PO2,PO3/PSO1,PSO3
CO5	PO2,PO3,PO5/PSO1,PSO3
CO6	PO1,PO2/PSO3
CO7	PO1,PO2,PO4/PSO3

BCSC 0008: Computer Networks

Objective: *The objective is to understand fundamental underlying principles of computer networking, details and functionality of layered network architecture.*

Credits: 03 **Semester - IV** **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Network Software:** Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Services, Service Primitives, The Relationship of Services to Protocols. Reference Models: The OSI Reference Model, The TCP/IP Reference Model. Example Networks: The Internet, Connection-Oriented Networks (X.25, Frame Relay & ATM), Ethernet. **Introduction Concepts**: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design, Physical Layer Transmission Media, Line coding scheme, switching methods (circuit switching, Packet switching), TDM. **Medium Access sub layer**: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols, CSMA, CSMA/CD, Overview of IEEE standards.	20
II	**Data Link Layer**: Error detection and correction, Flow control (sliding window protocol) **Network Layer**: Network Layer –IP addressing, subnet, CIDR, VLSM, Internetworking, Address mapping, routing. Connecting devices. **Transport Layer**: Transport Layer - Design issues, connection management, Flow control, TCP window management, congestion control-slow start algorithm. **Application Layer**: Data compression, Data Encryption, File Transfer, DNS, HTTP, SMTP, TELNET **Introduction to IPv6, transition from IPv4 to IPv6.**	20

Text Books:

- Forouzan B. A. , "Data Communication and Networking", 4th Edition, McGrawHill, 2004.

References:

- Kurose, J.F. and Ross K.W. , "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Addison-Wesley, 2005.
- A.S. Tanenbaum , "Computer Networks", 2nd Edition, Prentice Hall India, 2006.

Focus: This Course focuses on Employability under CO1,CO4,CO5.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the concept of OSI and TCP/IP reference model.
- CO2: Understand the basics of data transmission at physical layer.
- CO3: Understand the channel allocation using ALOHA, CSMA and CSMA/CD.
- CO4: Apply error detection and correction technique to eliminate transmission error.
- CO5: Analyze the fixed and variable length address (IPv4) subneting for the given scenarios.
- CO6: Understand the design issues of the transport layer.
- CO7: Understand the mechanism of protocols at application layer such as FTP, HTTP, Telnet, DNS.
- CO8: Understand IPv6 addressing and differentiate it from IPv4.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs

CO1	PO1,PO3,PO12/PSO1
CO2	PO1/PSO2
CO3	PO1,PO4/PSO1,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO4,PO6/PSO3
CO6	PO2,PO4/PSO1
CO7	PO5,PO12/PSO2
CO8	PO4,PO7/PSO4

BCSC0009: SOFTWARE ENGINEERING

Objective: *Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility.*

L–T–P-J: 3–0–0-0

Credits: 03

Module No.	Content	Teaching Hours
I	**Introductory Concepts**: The evolving role of software – characteristics, components and applications. **A Generic view of process:** Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. **Process Models:** Waterfall Model, Prototyping, Incremental, Spiral. **Agile software Development**: Introduction to Agile, Agile software development framework. **Software Requirement Specification**: Requirement Process, SRS Components, Requirement Specifications with Use Cases Diagram. **Software Project Planning:** Project Planning Objectives. **Software Metrics:** Size, Function Point, Staffing, Project Estimation Methods–COCOMO Model. **Function-Oriented Design**: Problem Partitioning, Abstraction, Top Down and Bottom Up Design. **Module-Level Concepts:** Coupling, Cohesion, Design Notation and Specification - Structure Charts; Structured Design Methodology - Data Flow Diagram, Sequence Diagram.	20
II	**OO Analysis and OO Design:** OO Concepts, Introduction to UML Design Patterns: Class Diagram, Activity Diagram, State Chart Diagram. **Coding**: Coding Process, Verification – Code Inspections, Software Metrics. **Testing Fundamentals**: Test Case Design, Black Box Testing Strategies, White Box Testing, Unit Testing, Integration Testing, System Testing. **Introduction to Automation Testing and Testing Tools:** Automated Testing Process, Framework for Automation Testing, Introduction to Automation Testing Tool. **Software Quality:** Models, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model. **Software Maintenance**: Models Cost of Maintenance, Re-engineering, Reverse Engineering.	18

Text Books:

- R. S. Pressman , "Software Engineering: A Practitioners Approach", 7thEdition, McGraw Hill, 2010.

Reference Books:

- K. K. Aggarwal and Yogesh Singh , "Software Engineering", 3rd Edition, New Age International Publishers, 2008.
- Rajib Mall , "Fundamentals of Software Engineering", 3rd Edition, PHI Publication, 2009.
- R.E Fairley , "Software Engineering", McGraw Hill, 2004.
- Sommerville , "Software Engineering", 9th Edition, Pearson Education, 2010.

Focus: This Course focuses on Employability under CO1,CO2,CO4.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of software engineering.
- CO2: Apply software processes to solve real world problems.

- CO3: Estimate the cost, effort and schedule of software using COCOMO Model.
- CO4: Analyze the software design techniques (structure chart, SDM, sequence diagram).
- CO5: Understand the basic concepts of OO analysis and design.
- CO6: Develop the test cases to validate the software.
- CO7: Understand the basic models of software Quality and maintenance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7/PSO1
CO2	PO2,PO3/PSO4
CO3	PO2,PO11/PSO3
CO4	PO3,PO10/PSO4
CO5	PO3,PO7/PSO1
CO6	PO5,PO12/PSO2
CO7	PO4,PO9,PO12/PSO1

BCSC0010: DISCRETE MATHEMATICS

Objective: *The objective is to introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in computer science.*

Credits: 4 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Sets, Relations and Functions:** Introduction to Set Theory, Venn diagrams, algebra of Sets, Inclusion-Exclusion Principle, Partitions, Proof Techniques, Relations, Properties and their types, Function and their types. Recurrence Relations and Generating Functions **Introduction to Counting Principle**: Permutation, Combination, Permutation with Repetition, Combination with Repetition, Pigeonhole Principle. **Probability Theory**: Introduction to Probability Theory, Conditional Probability, Total Probability, Bayes' Theorem.	20
II	**Propositional Logic -** Logical Connectives, Truth Tables, Normal Forms (Conjunctive and Disjunctive), Validity; **Predicate Logic -** Quantifiers, Inference Theory, Methods of Proof: Direct, Indirect, Mathematical Induction. **Algebra**: Motivation of Algebraic Structures, Finite Groups, Subgroups and Group Homomorphism; Lagrange's Theorem; Commutative Rings and Elementary Properties; **Graph Theory:** Introduction to Graphs, Types: Planner, Directed, Complete, Bipartite Graph, Isomorphism , Euler Graph, Hamiltonian Graph, Operations on Graphs, Representation of graphs, Connectivity.	20

Text Book:

- Kenneth H Rosen , "Discrete Mathematics and Its Applications", 7th edition, TMH, 2012.

Reference Books:

- J.P. Tremblay , "Discrete Mathematical Structures with Applications to Computer Science", TMH, New Delhi, 1997.
- V. Krishnamurthy , "Combinatorics: Theory and Applications", East-West Press, New Delhi, 1986.
- Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics- An Applied Introduction", 5th Edition, Pearson Education, 2004.
- C.L. Liu , "Elements of Discrete Mathematics", 2nd Edition, TMH, 2000.

Focus: This Course focuses on Employability under CO1,CO2,CO5,CO8.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the notion of mathematical thinking and proofs to solve the problem.
- CO2: Apply the basics of discrete probability and number theory to solve the real world problem.
  CO3: Analyze basic discrete structures and algorithms using effectively algebraic techniques.
- CO4: Analyze mathematical concepts like sets, reasoning, relational algebra and graph theory to solve optimization problems.
- CO5. Analyze the validity of an argument using logical notation.
- CO6. Demonstrate the basic structures of proof techniques to write and evaluate the validity of arguments.
- CO7. Understand the basic principles of sets, set equalities and operations in sets.
- CO8. Apply counting principles to determine probabilities.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO3
CO2	PO1,PO3/PSO4
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3
CO5	PO1,PO2/ PSO3
CO6	PO1,PO3/PSO2,PSO3
CO7	PO1,PO2/PSO1
CO8	PO1,PO3/PSO1,PSO4

BCSC0011: THEORY OF AUTOMATA & FORMAL LANGUAGES

Objective: *The objective of this course is that students will study and compare different models and views of the abstract notion of computation and its various aspects.*

Credits:04 **Semester V** **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem; FA with Output - Moore and Mealy machine, Applications and Limitations of FA. **Regular expression (RE):** Regular Expression to FA, DFA to Regular Expression, Arden Theorem, Non Regular Languages, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages. **Push Down Automata (PDA):** Introduction, Language of PDA, Acceptance by Final State, Acceptance by Empty Stack, Deterministic PDA.	20
II	**Context Free Grammar (CFG) and Context Free Languages (CFL):** Introduction, Derivation Trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Simplification of CFGs, Normal Forms for CFGs - CNF and GNF; Pumping lemma for CFLs, Equivalence of PDA and CFG. **Turing machines (TM):** Basic Model, Definition and Representation, Variants of Turing Machine and their equivalence, TM for Computing Integer Functions, Universal TM, Church's Thesis, Recursive and Recursively Enumerable Languages, Halting Problem, Introduction to Computational Complexity. **Decidability:** Post's Correspondence Problem (PCP), Rice's Theorem, Decidability of Membership, Emptiness and Equivalence Problems of Languages.	20

Text Books:
- K.L.P. Mishra and N. Chandrasekaran , "Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI, 2006.

Reference Books:
- Hopcroft, Ullman , "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2013.
- Martin J. C ," Introduction to Languages and Theory of Computations", 4th Edition, TMH, 2011.

Focus: This Course focuses on Employability under CO1,CO2,CO5,CO6.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of Context Free languages, Expression and Grammars.
- CO2: Analyze the conversion of NFA to DFA, Mealy to Moore and Moore to Mealy.
- CO3: Analyze the process to convert regular expression to DFA, DFA to regular expression, and minimization of DFA.
- CO4: Develop the PDA for the context free language and context free grammar.
- CO5: Analyze that the grammar is ambiguous or unambiguous.
- CO6: Apply the process to convert CFG to CNF and GNF.
- CO7: Understand the concept of Turing machine and its variants.
- CO8: Design the Turing machine for the real world application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO4
CO2	PO2,PO3/PSO3
CO3	PO2,PO3,PO9,PO12/PSO1,PSO3,PSO4
CO4	PO1,PO3,PO5,PO9/PSO3,PSO4
CO5	PO1,PO2,PO4/PSO3
CO6	PO2,PO3/PSO3
CO7	PO1,PO2/PSO1,PSO3
CO8	PO3,PO12/PSO1,PSO2,PSO3

BCSC0012: DESIGN & ANALYSIS OF ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and concepts including Trees, Recursion & Dynamic programing.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Algorithms, analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Sorting and order Statistics - Shell sort, Quick sort, Merge sort, Heap sort, Comparison of sorting algorithms, Sorting in linear time. **Advanced Data Structures:** Red-Black trees, B – trees, Binomial Heaps, Fibonacci Heaps. Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching.	20
II	Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets Dynamic programming with examples such as Knapsack. All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem	20

Text Books:

- Thomas H. Coremen, Charles E. Leiserson and Ronald L. Rivest, Introduction to Algorithms, Third edition, Prentice Hall of India, 2008.

Reference Books:

- Gilles Brassard Paul Bratley ," Fundamentals of Algorithms", Prentice Hall, 1996.
- Ellis Horowitz, SartajSahni, SanguthevarRajasekaran , "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd, 2008.
- Levitin , "An Introduction to Design and Analysis of Algorithms", Pearson, 2008.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO8.

Outcome: After completion of course, student will be able to:

- CO1: Understanding of complexity representation in terms of Big Oh, Theta and Omega notations.
- CO2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms (quick sort and merge sort).
- CO3: Compare and analyze different data structures (RB Tree, B Tree, Binomial Heaps, Fibonacci Heaps).
- CO4: Understand the major graph algorithms (DFS, BFS, Dijkstra's Bellman Ford) and their analyses.
- CO5: Understand the greedy paradigm and able to analyze when an algorithmic design situation calls for it. Synthesize greedy algorithms (Optimal Reliability Allocation, Minimum Spanning Trees, factorial Knapsack) and analyze them.
- CO6: Synthesize dynamic-programming algorithms (0/1 knapsack problem, Resource allocation problem, Warshal's and Floyd's algorithms) and analyze them.

- CO7: Understand the backtracking paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize backtracking algorithms (N Queen Problem, TSP Problem, sum of subsets problem, Graph Coloring) and analyze them.
- CO8: Understand the branch and bound paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize branch and bound algorithms (N Queen Problem, TSP Problem, Hamiltonian Cycles, Graph Coloring) and analyze them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4,PO12/PSO1,PSO3
CO2	PO1, PO3,PO4,PO5/PSO1,PSO3
CO3	PO1,PO3, PO6/PSO1,PSO3
CO4	PO1,PO2,PO3, /PSO1,PSO3
CO5	PO1,PO2 /PSO1,PSO3
CO6	PO1,PO2,PO3, PO6/PSO1,PSO3
CO7	PO1,,PO4,PO12/PSO1,PSO3
CO8	PO1,PO2,PO3,PO4,PO12/PSO1,PSO2

BCSC 0600: INTRODUCTION TO OPEN SOURCE SOFTWARE AND OPEN STANDARDS

Objective: *The concept of Open Source Software and to learn the Open Source Adoption History and Evolution, Various types of Open Source Software its strength and Concept of standards and licenses and its types.*

Credits: 02 **Semester - I** **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Open Source:** Introduction to Open Source Software - History of Open Source Software, Initiation of Open Source project start; Open Source Software examples: The Origins, The GNU projects, The Operating System GNU/Linux, The Graphical User Interface KDE/GNOME, Apache Web Server, **Application Software**; Strengths and Advantages of Open Source Software - Network effects, Lower cost, Availability, Maintainability. Drivers for Adoption - Lower cost of ownership, Quality, Innovation reuse, Technical competence; Open Source Software Assessment, Examples of Open Source Adoption in the World, Open Source Challenges. Standards, Licenses, Contribution to open source community-Evolution of UNIX, GNU General Public License - Genesis of GNU Myth Buster, Brook's law; Open Source Community; Apache Web Server; Apache Software Foundation (ASF); How to contribute to open source projects.	13
II	**Introduction to standards**, Types of standard, Lifecycle of standard, Importance and benefits of standards. **Adoption of Open Source**: Introduction; Drivers for Open Source adoption; Adoption Methods and Process; examples of Open Standard Adoptions in the World; Open Source Challenges **.Case Study On Open Standard and Software:** Introduction. Case Study 1 - Open Standard Case Study 2 - Linux - The Operating System – an Overview, Linux Basics, Various Linux distributions available, Preparing for Installation – Installation Checklist, Hardware Requirements, Partitioning, Installation problems ,Working with the System, Shells and Utilities, Linux commands, File Handling using vi editor, Getting familiar with shell scripts	13

Text Books:

- Introduction to Open Source Software & Open Standards (IBM ICE Publication)

Reference Books:

- Handbook of Research on Open Source Software: Technological, Economic, and Social Perspectives by Kirk St. Amant and Brian Still - IGI Global © 2007.
- Open Source: Technology and Policy by Fadi P. Deek and James A. M. McHugh - Cambridge University Press © 2008.

- Perspectives on Free and Open Source Software by Joseph Feller, Brian Fitzgerald, Scott A. Hissam and Karim R. Lakhani (eds) The MIT Press © 2005.
- Understanding Open Source and Free Software Licensing First Edition , Annotated by Andrew M. St. Laurent

Focus: This Course focuses on Employability under CO1,CO2,CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Explain Open Source Software and the History of Open Source Software.
- CO2: Explain Application Software and Open Source Software Assessment.
- CO3: Understand the basics of open Standards.
- CO4: Understand the reason associated with open source Adoption.
- CO5: Implement the shell commands and shell scripts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO1/PSO1
CO4	PO1/PSO1
CO5	PO1,PO2/PSO1

BCSC 0601 WEB PROGRAMMING THROUGH PHP & HTML

Objective: *This course introduces the building of dynamic web solutions using PHP programming and OO concepts and its connectivity with database.*

Credits: 03 | **Semester II** | **L–T–P-J: 3–0–0-0**

Module No.	Content	Hours
I	**Introduction to Client Server Architecture**: Components of Client-Server Application, Client-Server Models and their Benefits, Characteristics of Web Projects, Static V/s Dynamic Websites and Web Portal. **Web Servers:** Introduction to prominent Web Servers, Installation of WAMP/XAMPP and Eclipse IDE **Client Side Implementation**: Introduction to HTML, Formatting tags, Meta, Anchor, List, Table, Headers, Frames and iframes, Image, Form, Fieldset, Legend, and other tags, their usage and implementation, Introduction of Formatting using CSS, Basics of Javascript, Statements, Functions in Javascript, Integrating Javascript with Various Elements of HTML, Validating a form using Javascript. **DOM:** Introduction, Methods and Properties and their usage. **PHP Basics**: Introduction to PHP, Basic Syntax of PHP, Embedding PHP in HTML, Comments, Variables, Constants, Managing Variables, Operators and Operator Precedence and String Manipulation functions. **Conditional Control Structures:** If statement, If- else statement, If- else if statement, Nested If, Switch statement. **Looping Control Structures:** For loop, While loop, Do- While loop, For-each, Break and Continue. **Functions in PHP**: Functions, User-Defined function, Call by value and call by references, Understanding variable scope, Global Variables, Static Variables, Include and Require, Built-in functions in PHP.	20
II	**Arrays**: Arrays and its types in PHP, Accessing Elements of an Array, Modifying Elements of an Array, Functions in array, Array Sorting, Multidimensional Array. **PHP File Handling:** Introduction, File Open, File Creation, Writing to files, Reading from File, Searching a record from a file, Closing a File. **Class and Object:** Introduction, Object, Class, Defining Class in PHP, Object in PHP, Usage of this variable, Constructor, Constructor with Parameters. **Exception Handling**: Introduction to Exception, Exception Handling mechanisms, Creating Custom Exceptions, Multiple Catch Blocks, Exception Propagation, Error Handling in PHP. **Form Handling and Session Management in PHP**: Accessing and displaying Form data from different Form components, Differences among $_GET, $_POST and $_REQUEST variables, Session management, Session operations, Session tracking mechanism, Clearing/Modifying data from session, Destroying a session, Setting and Retrieving Cookies, Uploading a file, displaying its details,	20

	restricting various details of a file during upload, checking for errors and reading Error code table. **Database Management**: Introduction to DBMS, SQL Basics, Database connectivity in PHP with MySQL, Executing Queries from frontend, **XML:** Introduction to XML, Parsing XML document using DOM parser, Various operations on XML document using PHP.	

Reference Books:

- IBM Student Guide on "Web Programming through PHP & HTML"
- Robin Nixon: "Learning PHP, MySQL and JavaScript" "O'Reilly Media, Inc.", July 2009.
- Dave W Mercer, Allan Kent, Steven D Nowicki, David Mercer, Dan Squier, Wankyu Choi – Beginning PHP, Wiley Publishing, Inc
- Ivan Bayross **-** "HTML, DHTML, JavaScript, Pearl & CGI", Fourth Revised Edition, BPB Publication
- "Programming PHP", RasmusLerdorf and Kevin Tatore, Shroff Publishers & Distributors Pvt.Ltd

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of client server architecture and its components.
- CO2: Explain the basics of web development using PHP and HTML.
- CO3: Develop a program using functions, control structures and array.
- CO4: Demonstrate the concepts of object and exception handling in PHP.
- CO5: Demonstrate web application using PHP,XML and MYSQL.
- CO6: Develop a dynamic/ static websites with server side programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PSO1
CO2	PO1,PSO1
CO3	PO1,PO3,PSO2
CO4	PO1,PO3,PSO2
CO5	PO1,PO3,PSO2
CO6	PO1,PO3,PSO2

BCSC0014: APPLIED DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database& NoSQL system. Students learn how to design and create a good database.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with case studies. **Data Modeling Using the Entity-Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. **Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, Non Redundant Cover, Canonical Cover, MVD and JDs, Inclusion Dependence.	26
II	**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication. **NoSQL System:** RDBMS vs NoSQL, BASE properties, Key-value, Columnar, Document and Graph-Based database, Introduction of MongoDB, Cassandra, Neo4j and Riak. **Database Programming using Python**: Database connectivity, Retrieving Data from Database, Parameters Passing, Executemany Methods, Cursor Attributes, Invoke Stored Procedures, Invoke Stored Functions.	26

Text Books:

- Elmasri and Navathe , "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010.

- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. &Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1,CO2,CO6.

Outcome: After completion of course, student will be able to:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss recovery system and be familiar with introduction to web database, distributed databases.
- CO8: Explain the differences between RDBMS and No-SQL,BASE properties and No-SQL databases.
- CO9: Design and implement the database system with the fundamental concepts of DBMS using Python.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2,PO3/PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3/PSO2
CO7	PO1,PO3/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO4
CO9	PO1,PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0800: COMPUTER PROGRAMMING LAB

Objective: *The objective is to provide a comprehensive study of the C programming language. It stress the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	• Mapping of flow chart, Algorithm, Language • Simple C-program execution • Programs based on various operators • Programs based on Decision and case Control Structure • Programs based on Loop Control Structure • Program based on special control statement ➢ break ➢ continue • Programs based on Array Insertion, Deletion, Linear Search & Bubble Sort • Programs based on String ➢ Length, Copy, Reverse, Concatenate, Compare with & without built-in functions • Programs based on Functions. • Programs based on Storage Class. • Programs based on Recursion. • Programs based on Preprocessor. • Programs based on Pointers • Programs based on array • Programs based on string • Programs based on call by value and call by reference • Programs based on Dynamic Memory Allocation • Programs based on User Defined Data types ➢ Structure and Union ➢ Enum and Typedef • Programs based on File handling ➢ Opening a file ➢ Reading, writing and appending a file ➢ Closing file ➢ Random Access to Files of Records • Programs based on Command Line Argument.	52

Reference Books:

- Herbert Schildt, “C: The Complete Reference”, 5th Edition, McGraw Hill Education
- K. N. King, “C Programming a Modern Approach”, W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, “The C Programming Language”, PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, “Programming in C”, Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: On Completion of this course, students are able to:

- CO1: Design programs involving decision structures, loops and functions.
- CO2: Understand the concepts of functions, recursion, pointers and file handling.
- CO3: Design programs involving structures, union and functions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO3,PO4/PSO1
CO3	PO3/PSO2,PSO4

BCSC0801: OBJECT ORIENTED PROGRAMMING LAB

Objective: *The objective of this course is that students will study and learn Object Oriented Modeling and programming.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	Programs in Java and python based on the concepts of: • Classes, Constructors, Polymorphism and Keyword Static. Programs based on the concepts of: • Inheritance, Multithreading Using Thread Class & Interface Runnable, String Handling, Generic Classes. Programs based on the concepts of: • Handling Database Connectivity. • Implementation of Collection Framework. Programs based on the concepts of: • Database Connectivity. • Retrieving Data from Database. • Parameters Passing, Execute many Method. • Cursor Attributes. • Invoke Stored Procedures. • Invoke Stored Functions.	24

Reference Books:

- Naughton, Schildt, “The Complete Reference JAVA2”, 9th Edition, Oracle Press.
- Bhave & Patekar, “Programming with Java”, Pearson Education
- Bret Slatkin: “Effective Python: 59 Specific ways to write better Python”, Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Implement object oriented language features.
- CO2: Design GUIs and Graphical programming.
- CO3: Design object oriented solutions for small systems involving database and event handling concepts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO5/PSO2
CO3	PO3,PO5/PSO4

BCSC0802: DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Generation of database report,.	24

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998
- Majumdar& Bhattacharya, "Database Management System", TMH

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Develop the SQL queries for real life scenarios.
- CO3: Implement the procedural language (PL/SQL) and Triggers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO1,PO2/PSO1,PSO4
CO3	PO2,PO3,PO5/PSO2,PSO3

BCSC0803: OPERATING SYSTEMS LAB

Objective: *The lab aims to develop understanding the operation of UNIX operating system.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implement the following basic commands (with options) used in UNIX/LINUX OS. • Write and implement the basic vi editor commands. • Shell scripts that use simple commands. • Decision based Shell scripts. • Shell scripts related to strings. • Shell scripts using pipes. • Shell scripts with loop statements. • Demonstration and solution for race condition. • Demonstration and use of System Calls. • Implement the basics of IPC in UNIX. • Implementation of Classical Problem in Concurrency	24

Reference Books:

- SibsankarHalder and Alex a Aravind ," Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Implement the basic operations on UNIX operating systems.
- CO2: Demonstrate the working of systems calls.
- CO3: Demonstrate message passing in Unix operating system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO4,PO5/PSO1,PSO2

BCSC0804: COMPUTER ORGANIZATION LAB

Objective: *The aim of the lab is to better understand the design of sequential Circuits such as Flip-Flops, Registers, and Counters.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• Bread Board Implementation of Flip-Flops. • Experiments with clocked Flip-Flops. • Design of Counters. • Bread Board implementation of Counters &Shift Registers. • Implementation of Arithmetic Algorithms. • Bread Board implementation of Adder/Subtraction (Half, Full). • Bread Board implementation of Binary Adder. • Bread Board implementation of Seven Segment Display. • Small Project based on combinational and sequential circuit. • Verify the excitation tables of various FLIP-FLOPS . • Design of an 8-bit ARITHMETIC LOGIC UNIT. • Design of 24x8 (16 byte) RAM. • Design of 24x8 (16 byte) STACK. . Implementation of a 4-bit PROCESSOR.	24

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4th edition, Elsevier Publication, 2008.
- William Stalling , "Computer Organization",8th Edition, PHI, 2011.
- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Implement the Combinational and Sequential Circuit.
- CO2: Demonstrate the working of counter and shift register.
- CO3: Demonstrate the working of ALU and seven segment displays.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO5/PSO2
CO2	PO3,PO4/PSO2
CO3	PO3,PO5/PSO1,PSO2

BCSC0805: DATA STRUCTURES & ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module		Lab
I &II	• Program to implement various operations in a singly linked list. • Program to implement insertion, deletion and traversal in a doubly linked List. • Program to implement polynomial addition using linked list. • Program to demonstrate the various operations on stack. • Program to convert an infix expression into postfix expression. • Program to evaluate a given postfix expression. • Program to implement Tower of Hanoi problem using Recursion. • Program to demonstrate the implementation of various operations on linear and circular queue. • Program to demonstrate the implementation of insertion and traversals on a binary search tree. • Program to implement Dijkstra's Algorithm to find the shortest path between source and destination. • Program to search a given element as entered by the user using sequential and binary search to search a given element as entered by the user. • Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort. • To write the following recursive functions for a singly-linked NULL-terminated list: insert(), traverse(), search().	24

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO3

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1

CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

BCSC0806: MICROPROCESSORS LAB

Objective: *The objective is to introduce the Architecture and programming of the microprocessor and learning about interfacing and various applications of microprocessor.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• To study 8085 microprocessor System. • To study 8086 microprocessor System. • To develop and run basic programs in 8085 ALP. • To develop and run programs in 8085 ALP related to the concept of looping, counting and indexing. • To perform interfacing of RAM chip to 8085/8086. • To perform interfacing of keyboard controller. • To perform interfacing of DMA controller. • To perform interfacing of UART/USART.	24

Reference Books:

- Ramesh S. Gaonkar , “Microprocessor Architecture Programming and Applications with 8085”, 4th Edition, Penram International Publishing, 2000.
- D. V. Hall , “Microprocessors and Interfacing: Programming and Hardware”, 2nd Edition, TMH, 1992.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the arithmetic and logical operations using assembly language programming (8085).
- CO2: Demonstrate the memory operations using assembly language programming (8085).
- CO3: Demonstrate the interfacing of Keyboard, DMA and UART controller.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO2/PSO1,PSO2
CO3	PO1,PO3,PO5/ PSO2

BCSC0807: DESIGN & ANALYSIS OF ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implementation of sorting algorithms: ○ Insertion Sort ○ Bubble Sort ○ Selection Sort ○ Divide and conquer approach: • Quick Sort • Merge Sort ○ Heap Sort ○ Counting Sort • Implementation of Searching Techniques: ○ Linear Search ○ Binary Search • Implementation of Matrix Multiplication • Implementation of Convex Hull • Implementation of Breadth First Search • Implementation of Depth First Search • Implementation of Greedy approaches: ○ Optimal Reliability Allocation. ○ Knapsack. Minimum ○ Minimum Spanning trees: • Prim's and Kruskal's algorithms. ○ Single source shortest paths – • Dijkstra's and Bellman Ford algorithms. • Implementation of Dynamic Programming: ○ Longest Increasing Subsequence. ○ Finding best path in maze. ○ Matrix Chain Multiplication ○ 0/1 Knapsack Problem ○ Resource Allocation Problem	32

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.
- CO2: Demonstrate and use the appropriate data structures for a given problem
- CO3: Implement the algorithms based on Greedy approach and Dynamic Programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO1,PSO2,PSO4
CO2	PO1,PO3,PO4/PSO1,PSO2,PSO3
CO3	PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0900: WEB PROGRAMMING THROUGH PHP & HTML LAB

Objective: *This course introduces the building of dynamic web solutions using PHP programming and OO concepts and its connectivity with database.*

Credits: 01 **Semester IV** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I&II	Static web applications using HTML/CSS Web applications using HTML & Javascript Programs using Decision Control Structures Programs using Loop Control Structures Programs using user defined functions Programs of Array handling and manipulation Programs of File handling and manipulation Programs using OO concepts in PHP Web applications with Form handling at server Web applications for managing sessions Web applications with connectivity with MySQL Web applications manipulating XML file	24

Reference Books:

- IBM Student Guide on “Web Programming through PHP & HTML”
- Robin Nixon: “Learning PHP, MySQL and Javascript” “O’Reilly Media, Inc.", July 2009.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: By the end of the class, students will learn to:

- CO1: Design websites with interactive web page(s) using HTML, CSS and JavaScript
- CO2: Design a responsive web site using HTML and CSS.
- CO3: Develop simple web application using server-side PHP programing with backend as MySQL.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2,PO5/PSO1

BCSC0808: APPLIED DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL and NoSQL databases.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Introduction to MongoDB and its Installation on Windows or Linux, Description of mongo Shell, create database and show database, Commands for MongoDB and To study operations in MongoDB – Insert, Query, Update, Delete and Projection • To implement Database connectivity using Python	24

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Majumdar & Bhattacharya, "Database Management System", TMH
- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

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Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Implement the procedural language (PL/SQL) and Triggers.
- CO3: Apply NoSQL queries in MongoDB.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO2,PO3,PO5/PSO2,PSO3
CO3	PO5/PSO2

BCSG0900: INTRODUCTION OF IoT

Objective: To learn the concepts of IOT, to learn Fundamentals of Electronics, To learn different applications in IOT, To learn different protocols used in IOT, To learn how to analysis the data in IOT.

Credits: 05 **L–T–P: 5–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Fundamentals of Electronics:** Basic gates, Multiplexers, De-Multiplexers, Encoders, Decoders, Switch, latch, flipflops, Registers. Ram's and Rom's (PROMS, EPROMS, EEPROMS) **Basics of IOT:** What is IOT? Network Architecture, Device Architecture, what is Embedded? Why we used Embedded system in IOT, Application of IOT. **Basic Hardware in IOT:** Basic Electronics Components of IOT, LED, Resistors, Capacitors, Transistors, Relay, Switch, Buzzer, LDR ,Potentiometer, PIR, How to glow LED without program, LED by switch, LED by two switch	25
II	**Controller use in IOT:** What is Arduino & ESP8266? History of Arduino & ESP8266, Hardware and Software Description, Fundamentals, Basic Arduino Programs, Serial Monitor and, Debugging Tool, Installing Board Packages, Installing Sensor Libraries, Interfacing Sensors **Tinkercad Simulation:** Basic Electronic Circuits, Arduino Simulation **Hands On Session Using Arduino And Esp8266:-**Programming Software, Glow the LED, Different pattern of LED, Pull up and pull down condition of switch, LED by switch and Servo Motor Interfacing ,LED by two switch and Ultrasonic Sensor Interfacing , Hello print on LCD, Different name pattern on LCD **IOT Communication Protocols:-**Wireless Protocols (SPI, I2C, UART,USRT), Networking Protocols(OSI Reference Model, TCP/IP, Ethernet), Sending data to Thingsboard.io/Adafruit.io	25

Text Books:

- DCS study material from portal,
- "Learning internet of Things" by Peter Waher

Reference Books: DCS study material, Thingworx academics

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the concepts of IOT.
- CO2: Identify the different technology.
- CO3: Apply the knowledge in different applications of IOT.
- CO4: Demonstrate the different protocols used in IOT.
- CO5: Understand the concepts of smart city development using IOT.
- CO6: Analyze the data in IOT.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3

CO2	PO2,PO3/PSO2
CO3	PO2,PO3,PO6,PO11/PSO1, PSO2,PSO4
CO4	PO1,PO3/PSO2
CO5	PO1,PO5/PSO1
CO6	PO2,PO3/PSO2

BCSG0901: IIoT COMMUNICATION & STANDARD INTERFACES

Objectives: Address the real world problems and find the required solution, Design the problem solution as per the requirement analysis done, Study the basic concepts of programming/ hardware/ emulator for Raspberry pi/Arduino.

Credits: 05 **L–T–P: 5–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Nodemcu:** Introduction to Nodemcu, Standard Protocols, interfacing with Sensors, connecting to the Cloud, Sending data to the Thingworx **IoT Applications:** Basics of WebApp Technology Stack, MVC Concept, Creating a Web Application **IoT Communication Protocol:-**Introduction to Protocol and Standards, HTTP / HTTPS, MQTT, CoAP, XMPP, DDS	25
II	**Raspberry Pi:** Fundamentals, Arduino VS Raspberry Pi, Installing Raspbian, Introduction to Python (Basics), CLI Commands, Setting Up Raspberry Pi Environment **Internet and Communication:** Fundamentals of Internet, TCP/IP Networking Components, Client and Server **Thingworx:** Thingworx Composer, Experiencing IoT Application, Creating Things, Creating Thing Templates, Creating Properties, Creating Alerts, Creating Subscription, Creating Mashup ,Mapping Thing Model to Mashup ,Application Keys , Thingworx REST API, MARS Rover Project	25

Text Books:

- *DCS study material from portal,*

- *Internet of Things (A Hands-On-Approach), By Arshdeep Bahga, Vijay Madisetti.*

Reference Books: *DCS study material, Thingworx academics*

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of programming/ hardware/ emulator for Raspberry pi/Arduino.
- CO2: Design the problem solution as per the requirement analysis done.
- CO3: Implement the mini project intended solution for project-based learning.
- CO4: Build and test the mini project successfully.
- CO5: Solve the real world problems.
- CO6: Understand the concepts of TCP/IP.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO2
CO2	PO1,PO2,PO3/PSO1,PSO4
CO3	PO1,PO2,PO3,PO5/PSO1,PSO2
CO4	PO2,PO3/PSO2
CO5	PO2,PO3 /PSO1, PSO2,PSO4
CO6	PO1,PO3/PSO2

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Industrial Internet of Things (IIoT)									
THEORY									
1.	BCSE0902	Smart Industrial Connectivity	4	0	0	0	4	4	
2.	BCSE0903	Data Science And Analytics	4	0	0	0	4	4	
3.	BCSE0904	Machine Learning	4	0	0	0	4	4	
4.	BCSE0905	Artificial Intelligence	4	0	0	0	4	4	
		TOTAL	**16**	**0**	**0**	**0**	**16**	**16**	

BCSE0902: SMART INDUSTRIAL CONNECTIVITY

Objectives: *To learn designing of User Interface and Layouts for Android App, to learn how to use intents to broadcast data within and between Applications.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Interfacing Raspberry Pi with Python:** Python Basic Programming, GPIO Pins Interfacing, Interfacing Sensors, **Thingworx:** Kapware Server, Connecting RPi to Thingworx, Real, Time patterns and anomaly detection, Integration tier & resource provider, Service tier, Thingworx apps. **ARM:** Embedded C and ARM Cortex Microcontrollers, Porting on, ARM Cortex Microcontrollers, Experience from building Osmosis platform, Vulnerabilities, Key aspects for Securing IoT solutions. **RFID:-**Introduction, Use Cases, Applications, interfacing with Arduino, Interfacing with RPi. **IoT Gateways:-**Introduction, Use Cases, Applications, interfacing with Arduino, Interfacing with RPi. **Bluetooth:-**Introduction, Use Cases, Applications, interfacing with Arduino, Interfacing with RPi. **ZigBee:-**Introduction, Use Cases, Applications, interfacing with Arduino, Interfacing with RPi, ZigBee Gateway Project.	25

II	**Raspberry Pi and Cloud Services:** Creating Local Server on RPi, Using RPi as a Gateway for IoT Devices, Cloud Architectures, Introduction to AWS, Deploying a Cloud Server, Setting Up a Cloud Server, Connecting RPi to Cloud, Sending and Receiving Data. **Data Management in IoT:-** Definition, IoT Data Lifecycle, IoT Data Management VS Traditional DBMS, AWS S3 Storage, AWS RDS Benefits of IoT Data Management. **Communication Channels:** GSM/GPRS, 2G, 3G, LTE, Wifi, PLC. **LPWAN:** LPWAN applications, LPWAN technologies, LoRA and LoRAWAN	25

Text Books:

- *DCS study material from portal,*
- *Internet Of Things (A Hands-on-Approach), By ArshdeepBahga, Vijay Madisetti.*

Reference Books: *DCS study material, Thingworx academics*

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Demonstrate the installing of Android Studio and Cross Platform Integrated Development Environment.
- CO2: Design the User Interface and Layouts for Android App.
- CO3: Demonstrate the use intents to broadcast data within and between Applications.
- CO4: Understand the use of Content providers and Handle Databases using SQLite.
- CO5: Understand the basics of Android APIs for Camera and Music system.
- CO6: Explain various security issues with Android Platform.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO2,PO3/PSO1,PSO3
CO3	PO3,PO5/PSO1,PSO2
CO4	PO2,PO3/PSO4
CO5	PO1,PO3 /PSO1,PSO4
CO6	PO1,PO3/PSO2

BCSE0903: DATA SCIENCE AND ANALYTICS

Objectives: Conceptualization and summarization of big data and machine learning, trivial data versus big data, big data computing technologies, machine learning techniques, and scaling up machine learning approaches

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Data Analytics and Big Data:** An Overview Session for the Data Analyst, Data Scientist, Getting Started with Jupyter Notebook, Introduction to the Open Data Science Learning and, Competitive Platforms, IoT and Big Data, IoT Analytics Platform, Use Cases. **Scientific Computing with Python – Numpy:-** Introduction to List and Dictionary:-Basic operations in List and Dictionary, Importance of Numpy, Array Creation, Data Types, Unary Operations ,Shape Manipulation, Reshape, Transpose, Ravel, Universal Functions, Matrix Operations (Addition, Multiplication, Transpose and Inverse), Statistical Methods, Stacking (vstack and hstack), Splitting, Shallow copy and Deep copy/Cloning. **Data Analysis Workflow in Python using Pandas:** Introduction to Pandas, Pandas Data Structures, importing files/exporting files (*introduction to OS library), Series & Data Frame, Basic Functions on Data Frame, Indexing & Selecting Data, Selection by Level, Selection by Position, Boolean Selection, Sorting, Group by: Split-Apply- Combine, Handling Missing Data (Missing imputation), Data Analysis Scenarios. **Advanced Data Analysis using Pandas:** Merging of Data Frame, (Concat and Merge), Reshaping: Stack, Unstack, Pivot, Dummy/Indicator Variables, Working with Databases.	25

II	**Data Analysis Scenarios:** Converting Series to Time Series, Handling Invalid Data, Date-Time Index, Indexing, Time/Date Components, Period & Period Index, Parsing & Manipulating Dates. **Data Visualization:-**Introduction, Creating Different Types of Plots Scatter Plots, Line Graphs, Bar Plots, X and Y Ticks and Rotations ,Histograms, Box Plot, Stacked Plots. **Connect Azure IoT Hub to Thingworx:-**Install, configure, and run the ThingWorx Azure IoT Hub Connector, import devices that exist in Azure into ThingWorx, Connect a simulated Azure device to ThingWorx Foundation server. **Configure Permissions:** Configure and utilize the user access system, Control permissions at design time and run time **ThingWorx Developer Portal:** Developer Portal Home, ThingWorx Trials, Navigation: Resources, Navigation: Platform , Navigation: Apps, Navigation: AR, Navigation: Support	25

Text Books:

- *DCS study material from portal,*
- *"python data science handbook" by jakev anderpass*

Reference Books: *DCS study material*

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the overview of an exciting growing field of Big Data analytics.
- CO2: Analyze the Big Data using traditional data mining algorithms.
- CO3: Apply the tools required to manage and analyze big data.
- CO4: Understand the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- CO5: Understand the many types of big data like data streams.
- CO6: Solve complex real-world problems in for decision support.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO2
CO2	PO1,PO2,PO4/PSO1,PSO2
CO3	PO3,PO4/PSO1,PSO3
CO4	PO2,PO3/PSO4
CO5	PO2,PO3 /PSO1,PSO4
CO6	PO1,PO3/PSO2

BCSE0904: MACHINE LEARNING

Objectives: To provide Machine learning techniques: Three phases of machine learning, types of learning, support vector machine, decision trees and random forests, deep learning.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Techniques of Machine Learning:** Supervised learning, Unsupervised learning, Semi-supervised and Reinforcement learning, NLP. **Data Preprocessing**: Data Preprocessing, Data preparation, Feature engineering, Feature scaling, Dimensionality reduction. **Supervised learning**: Simple & Multiple Linear Regression, Interaction Terms, Nonlinear Transformations, Dummy variable regression, K-fold Cross Validation, Subset selection methods, Penalization [Ridge, Lasso, ElasticNet. **Introduction to Logistic Regression:** The Logistic Model cost function, Estimating the Coefficients, Making Predictions, Odds-Ratio, Performance Evaluation Matrices, [Sensitivity/Specificity/PPV/NPV, Precision, ROC curve etc.], Regularized Logistic Regression.	25
II	**Support Vector Machines**: Optimization Objective, The Maximal Margin Classifier, Kernel Method and Nonlinear Decision Boundaries One versus One Classification, One versus All Classification, Using Support Vector for Regression, Character recognition using SVM, Advantage and Disadvantages of SVM. Supervised learning:, Decision Tree:- CHAID, CART. **Supervised learning:** Random Forest: Motivating Random Forests: Decision Trees, Application of Random Forest, Ensembles of Estimators: Random Forests, Bagging and boosting, Example: Random Forest for Classifying Digits. Summary of Random Forests, Advantage and Disadvantages of RF. KNN (K-Nearest Neighbour):- Background of KNN, Application of KNN, Create a document retrieval system using k-nearest neighbors., Identify various similarity metrics for text data., Reduce computations in k-nearest neighbor search by using KD trees., Advantage and Disadvantages of KNN	25

Text Books:

- *DCS study material from portal,*
- *"python data science handbook" by jake vanderpass*

Reference Books: *DCS study material*

Focus: This Course focuses on Employability under CO1,CO2,CO5.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply the basic concepts of machine learning including bias-variance tradeoff.
- CO2: Apply the concepts of regression.
- CO3: Conceptualize supervise and re-enforcement learning for classification.
- CO4: Formulate the ensemble methods for improving classification.
- CO5: Apply ANN with optimization in machine learning.
- CO6: Design and develop projects based on machine learning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2,PO3/PSO1
CO3	PO4/PSO1,PSO3
CO4	PO2,PO3/PSO4

CO5	PO2,PO4/PSO4
CO6	PO1/PSO2,PSO4

BCSE0905: ARTIFICIAL INTELLIGENCE

Objectives: To create appreciation and understanding of both the achievements of AI and the theory underlying those achievements.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Supervised learning:** Introduction to Deep Learning: -Biological, neurons and artificial neurons, Non-linear Hypothesis, Model Representation, Examples & Intuitions, Transfer Function/ Activation Functions, Typical classes of network architectures, Feed forward ANN, Structures of Multi-layer feed forward networks, Back propagation algorithm, Back propagation. training and convergence, Local minima and global minima, Practical and design issues of back propagation learning, Advantage and Disadvantages. **Supervised learning: Ensemble and Stacking Model: -**Un -Supervised learning: Dimension Reduction Techniques: -Principal, Component Analysis (PCA), Eigen Value and Eigen Vectors,VARIMAX Rotation, Component Loading.	25
II	**Un - Supervised learning: Clustering**:-K means clustering, Fuzzy C means & K prototype, Application of Clustering algorithms Introducing different distance measure (Euclidean, Cosine,, Hamming etc), Measure of goodness of clusters o Davies-Bouldin Index, Dunn Index, Silhoutte coefficient, Advantages and Disadvantages of clustering algorithms. **Un - Supervised learning:** Recommendation Engine: -Collaborative filtering(CF), Item Based CF, User Based CF **NLP - Natural Language Processing:-**Introduction to Text mining and its importance, Text wrangling and cleansing, Tokenizing text and word net basics, Sentiment Analysis, Word cloud, Text Classification - Naive Bayesian. Text clustering, Topic mining - LDA (Latent Dirichlet allocation)	25

Text Books:

- *DCS study material from portal,*
- *"python data science handbook" by jake vanderpass*

Reference Books: *DCS study material*

Focus: This Course focuses on Employability under CO1,CO2,CO5.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basics of AI and the application areas.
- CO2: Apply the basic concepts of machine learning including bias-variance tradeoff, sample and true error.
- CO3: Explain the Supervised learning and un-supervised learning.
- CO4: Formulate the ensemble methods for improving classification.
- CO5: Design use of ANN with optimization in machine learning.
- CO6: Design and develop projects based on machine learning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3/PSO1,PSO3
CO2	PO2,PO3/ PSO3
CO3	PO2/PSO1,PSO3
CO4	PO2,PO3/PSO4
CO5	PO3,PO4/PSO2,PSO4
CO6	PO1,PO3/PSO2,PSO4

COURSE STRUCTURE

B.TECH.

COMPUTER SCIENCE & ENGINEERING

Specialization

in

Internet of Things (IoT)

Under

Choice Based Credit System (CBCS)

Vision

To impart quality education in the field of computer science and engineering using contemporary research to meet the growing needs of the industry and society.

Mission

M1: To disseminate quality education by inculcating problem analyzing and solving skills to become successful professionals.
M2: To promote research that caters the need of industries and society.
M3: To imbibe organizational integrity and professional ethics to develop good human beings.

Program Educational Objectives (PEOs)

PEO1: Become globally competent computer professionals, researchers or entrepreneurs, for developing sustainable solutions.

PEO2: Attain positions of leadership in an organization and /or on teams.

PEO3: Engage in lifelong learning to improve their professional skills and knowledge to address industrial and societal needs using latest technologies.

Program Specific Outcomes (PSOs)

PSO1: Solve real world problems using competency in computational logic, analytical ability, system design principles and programming skills.

PSO2: Design and develop hardware and software interfaces along with latest tools and technology to meet the needs of industry.

PSO3: Analyze the algorithmic principles, theory of computation, internet of things and mathematical foundations for the modeling and design of computing systems.

PSO4: Apply knowledge to provide innovative solutions to existing problems and identify research gaps.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics and science, with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE.

PO2: Problem Analysis: Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of solutions: Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations.

PO4: Conduct Investigations of Complex problems: Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development

PO8: Ethics: Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

PO12: Life-Long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change.

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BPHS0001	Engineering Physics	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication – I	2	0	0	2	2
4.	BECG0001	Electronics Engineering	3	1	0	4	4
5.	BCSG0001	Python Programming	4	1	0	5	5
6.	BCSC0604	Introduction to Internet of Things	2	0	0	2	2
PRACTICALS							
7.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
8.	BELH0801	English Language Lab – I	0	0	2	1	2
9.	BECG0800	Electronics Lab I	0	0	2	1	2
10.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
11.	BCSG0800	Python Programming Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**26**	**31**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BCHS0101	Engineering Chemistry	3	1	0	4	4
3.	BELH0002	English Language Skills for Communication – II	2	0	0	2	2
4.	BEEG0001	Electrical Engineering	3	1	0	4	4
5.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
6.	BCSC0605	Sensor Technology & Instrumentation	3	0	0	3	3
PRACTICALS							
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	1	2
8.	BELH0802	English Language Lab – II	0	0	2	1	2
9.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
10.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1	2
11.	BCSC0902	Sensor Technology & Instrumentation Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**26**	**31**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0103	Engineering Mathematics III	3	1	0	4	4
2.	BELH0006	Ethics & Values	2	0	0	2	2
3.	BELH0003	English for Professional Purpose – I	2	0	0	2	4
4.	BCSC0002	Object Oriented Programming	3	0	0	3	3
5.	BCSC0003	Database Management System	3	0	0	3	3
6.	BCSC0005	Computer Organization	3	0	0	3	3
7.	BCSE0651	Wireless Sensor Networks &IoT Standards	3	0	0	3	3
8.		Mandatory Non Graded– I	0	0	0	0	2
PRACTICALS							
10.	BCSC0801	Object Oriented Programming Lab	0	0	2	1	2
11	BCSC0802	Database Management System Lab	0	0	2	1	2
12.	BCSC0804	Computer Organization Lab	0	0	2	1	2
	BCSE0681	Wireless Sensor Networks &IoT Standards Lab	0	0	2	1	2
13.	BTDH0301	Soft Skills – I	0	0	2	1	2
		TOTAL				**25**	**34**

Forth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BCHS0201	Environmental Studies	2	0	0	2	2
2.	BELH0004	English for Professional Purpose – II	2	0	0	2	4
3.	BCSC0006	Data Structures & Algorithms	3	1	0	4	4
4.	BCSC0007	Introduction to Microprocessors	3	0	0	3	3
5.	BCSC0008	Computer Networks	3	1	0	4	4
6.	BCSC0004	Operating System	3	0	0	3	3
7.	BCSC00010	Discrete Mathematics	3	1	0	4	4
8.	BCSE0503	Cloud Computing Architecture & Deployment Models	3	0	0	3	3
9.		Mandatory Non Graded - II	0	0	0	0	2
PRACTICALS							
10.	BCSC0805	Data Structures & Algorithms Lab	0	0	2	1	2
11.	BCSC0806	Microprocessors Lab	0	0	2	1	1
12.	BCSE0532	Cloud Computing Architecture & Deployment Models Lab	0	0	2	1	1
13.	BTDH0302	Soft Skills – II	0	0	2	1	2
14.	BCSC 0803	Operating System Lab	0	0	2	1	2

		TOTAL				**30**	**37**

Fifth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BCSC0011	Theory of Automata & Formal Language	3	1	0	4	4
2.		Design and Analysis of Algorithms	3	1	0	4	4
3.	BCSE0653	Descriptive Analytics for IoT	3	0	0	3	3
4.		Soft Skills	8	0	0	4	8
5.	BCSE0654	Ipv6 Analysis and Applications	3	0	0	3	3
6.	BCSC 0009	Software Engineering	3	0	0	3	3
7.		Open Elective	4	0	0	4	4
8.		Mandatory Non Graded - II	0	0	0	0	2
PRACTICALS							
10.	BCSC0805	Mini Project	0	0	0	2	0
11.	BCSC0806	Industrial Training	0	0	0	2	0
12.	BCSE0683	Descriptive Analytics for IoT Lab	0	0	1	1	2
		TOTAL				**30**	**33**

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
THEORY									
1.	BCSC1001	Computer Programming	3	1	0	0	4	4	
2.	BCSC0002	Object Oriented Programming	3	0	0	0	3	3	Programming
3.	BCSC0003	Database Management System	3	0	0	0	3	3	
4.	BCSC0004	Operating Systems	3	0	0	0	3	3	
5.	BCSC0005	Computer Organization	3	0	0	0	3	3	
6.	BCSC0006	Data Structures & Algorithms	3	1	0	0	4	4	Programming
7.	BCSC0007	Introduction to Microprocessors	3	0	0	0	3	3	Computer Organization
8.	BCSC0008	Computer Networks	3	1	0	0	4	4	
9.	BCSC0009	Software Engineering	3	0	0	0	3	3	
10.	BCSC00010	Discrete Mathematics	3	1	0	0	4	4	
11.	BCSC0011	Theory of Automata & Formal Language	3	1	0	0	4	4	
12.	BCSC0012	Design & Analysis of Algorithms	3	0	0	0	3	3	Data Structures
13.	BCSC0604	Introduction to Internet of Things	2	0	0	0	2	2	
14.	BCSC0605	Sensor Technology & Instrumentation	3	0	0	0	3	3	
15.	BCSC0014	Applied Database Management System	4	0	0	0	4	4	
PRACTICALS									
1.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
2.	BCSC0801	Object Oriented Programming Lab	0	0	2	0	1	2	Programming Lab
3.	BCSC0802	Database Management System Lab	0	0	2	0	1	2	
4.	BCSC0803	Operating Systems Lab	0	0	2	0	1	2	
5.	BCSC0804	Computer Organization Lab	0	0	2	0	1		
6.	BCSC0805	Data Structures & Algorithms Lab	0	0	2	0	1	2	Programming Lab
7.	BCSC0806	Microprocessors Lab	0	0	2	0	1	2	
8.	BCSC0807	Design & Analysis of Algorithms Lab	0	0	2	0	1	2	Programming, Data Structures
9.	BCSC0902	Sensor Technology & Instrumentation Lab	0	0	2	0	1	2	
10.	BCSC0808	Applied Database Management System	0	0	2	0	1	2	
		Total	**45**	**5**	**29**	**0**	**60**	**68**	

Program Elective (Only for IBM Programme)

S. NO.	SEMESTER	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Internet of Things(IoT)									
THEORY									
1.	BCSE0651	Wireless Sensor Networks &IoT Standards	3	0	0	0	3	3	
2.	BCSE0652	Cloud Architecture and Deployment Models	3	0	0	0	3	3	
3.	BCSE0653	Descriptive Analytics for IoT	3	0	0	0	3	3	
4.	BCSE0654	Ipv6 Analysis and Applications	3	0	0	0	3	3	
5.	BCSE0655	Big Data Analytics	2	0	0	0	2	2	
6.	BCSE0656	IoT for Industries	2	0	0	0	2	2	
7.	BCSE0657	Designer of Smarter Cities	2	0	0	0	2	2	
PRACTICALS									
1.	BCSE0681	Wireless Sensor Networks &IoT Standards Lab	0	0	2	0	1	2	
2.	BCSE0682	Cloud Architecture and Deployment Models Lab	0	0	2	0	1	2	
3.	BCSE0683	Descriptive Analytics for IoT Lab	0	0	2	0	1	2	
4.	BCSE0684	Big Data Analytics Lab	0	0	2	0	1	2	
Total			**18**	**0**	**8**	**0**	**22**	**26**	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BCSJ0950	Mini Project – I	0	0	0	0	2	0	
2.	BCSJ0951	Mini Project – II	0	0	0	0	2	0	
3.	BCSJ0971	Project – Part I	0	0	0	0	3	0	
4.	BCSJ0972	Project – Part II	0	0	0	0	8	0	
5.	BCSJ0991	Industrial Training	0	0	0	0	2	0	
		TOTAL	**0**	**0**	**0**	**0**	**17**	**0**	

Mandatory Non Graded Course

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
		THEORY							
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
5.	BCHM0202	Environmental Studies	2	0	0	0	2	2	
6.	BELM0001	Introduction to Bhagavad Gita	2	0	0	0	2	2	
		TOTAL	**12**	**0**	**0**	**0**	**0**	**12**	

Humanities and Social Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purposes – I	2	0	0	0	2	2	
4.	BELH0004	English for Professional Purposes – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAH0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	8	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	8	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG0001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BCSG0001	Python Programming	4	1	0	0	5	5	
PRACTICALS									
5.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
6.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
7.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
8.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
9.	BCSG0800	Python Programming Lab	0	0	2	0	1	2	

BCSG0001: PYTHON PROGRAMMING

Objective: *This course introduces the solving of mathematical problems using Python programming using OO concepts and its connectivity with database.*

Credits:05 **L-T-P-J:4-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Python:** Introduction and Basics; Setting up path Python Data Variables & Operators: Data Variables and its types, id () and type () functions, Coding Standards; **Control Structures:** if-else, elif, Nested if, Iteration Control structures, Break, Continue & Pass; **String Manipulation:** Accessing Strings, Basic Operations, String slices Function and Methods. **Lists:** Introduction, accessing list, Operations, Working with lists, Function and Methods. **Tuple:** Introduction, accessing tuples, Operations, Working, Functions and Methods. **Dictionaries:** Introduction, accessing values in dictionaries, Working with dictionaries, Properties ,Functions.	22
II	**Functions:** Defining & Calling a function, Passing arguments to functions – Mutable & Immutable Data Types, Different types of arguments, Recursion, Scope of variables; **Modules and Packages:** User-defined modules and Standard Library: random, numpy, scipy, sys, Math Module, String Module, List Module, Date & Time Module, Regular Expressions: match, search, replace; **Input-Output:** Printing on screen, reading data from keyboard, Opening and closing file, Reading and writing files, Functions. **Exception Handling:** Exception, Exception Handling, except clause, try? finally clause, User Defined Exceptions. Basics of Python for Data Analysis, Introduction to series and data frames & Python using Pandas.	22

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO7.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basics of Python Programming.
- CO2: Apply the concepts of control structures and string manipulations of python programming.
- CO3: Understand the use of data structures available in Python List, Tuple and Dictionary.
- CO4: Experiment user-defined functions and access built-in functions.
- CO5: Experiment user-defined modules and access built-in modules- math, random, string, date, time, date time.
- CO6: Develop the programs using the concept of File Handling.
- CO7: Develop programs based on Exceptional Handling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO4
CO2	PO4/PSO1
CO3	PO5/PSO4
CO4	PO5,PO7/PSO1
CO5	PO2,PO8/PSO4
CO6	PO3,PO10/PSO2
CO7	PO5,PO9/PSO1

BCSC0001: COMPUTER PROGRAMMING

Objective: *To impart adequate knowledge on the need of problem solving techniques and develop programming skills to implements applications using the concepts of C Language. Also by learning the programming constructs they can easily switch over to any other language in future.*

Credits:05 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Generation of Programming Languages:** Low, Assembly, High and 4GL. **Language Processors:** Compiler, Interpreter, Assembler, Linker and Loader. **Algorithm:** Introduction, Features, Different Ways of stating Algorithms. **Flow Chart:** Introduction, Standard, Guidelines, Advantages and Limitations of using Flowcharts. **Basics of C:** Overview, Structure of a C program, Identifier, Keywords, Variables, Data types, Formatted Input and output. **Operators and Expression:** Assignment, Unary, Arithmetic, Relational, Logical, Bitwise, Conditional, Special operators and their precedence & Associativity. IEEE representation of data types like float & double, Lvalue and Rvalue **Type Conversion:** Type Promotion in expression, Conversion by Assignment, Truncation and Casting Arithmetic expression. **Decision and Case Control Structure:** if, if-else, nested if-else, Decisions using switch, switch versus if-else ladder, goto. **Loop Control Structure:** For loop, while loop, do-while loop, nesting of loops, break, and continue. **Arrays:** Introduction, one-dimensional and two-dimensional Array-Declaration, Initialization, Address Calculation. **Operations on Arrays:** Insertion, Deletion, Linear Search & Bubble Sort. **String:** Introduction, One dimensional and two dimensional Array-Declarations, Initialization **Operations on String:** Length, Copy, Reverse, Concatenate, Compare with & without built-in functions.	25

II	**Functions:** Declaration and Definition, Category of Functions, Parameter Passing Techniques – Call by Value, Passing Arrays to Functions. **Introduction to Storage Classes:** Auto, Static, Extern and Register. **Recursion:** Mechanics of Recursive Call, Implementation of Recursion, Recursion vs. Iteration. **The C Preprocessor:** Introduction, Macro Expansion and File Inclusion, Conditional Compilation and Miscellaneous Directives. **Pointers:** Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Arrays and Pointers, Pointer and Strings, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointer to an Array, Two Dimensional Array and Pointers, Pointers to Functions, Dynamic Memory Allocation, void Pointer and Null Pointer. **User Defined Types:** enum, typedef, Union and Structure - Declaration, Initialization, Nested Structures, Arrays of Structures, Structure and Pointer, Passing Structure Through Function. Difference between Structures and Union. **File Handling:** Data and Information, File Concepts, File Organization, File Operations: Open, Read, and Close, Trouble in Opening a File. File Opening Modes, Working with Text Files. Random Access to Files of Records. Introduction to Command Line Arguments.	25

Text Books:

- Behrouz A. Forouzan and Richard F. Gilberg, “Computer Science – A Structured Programming Approach Using C”, C Language Learning, 2007

Reference Books:

- Herbert Schildt, “C: The Complete Reference”, 5th Edition, McGraw Hill Education
- K. N. King, “C Programming a Modern Approach”, W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, “The C Programming Language”, PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, “Programming in C”, Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1,CO2,CO3CO7,CO8.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of problem solving skills.
- CO2: Apply the basic principles of programming in C language.
- CO3: Understand the concepts of arrays and strings in C language.
- CO4: Apply the concepts of functions to solve real world problems.
- CO5: Illustrate the concepts of recursion.
- CO6: Understand the concepts of pointers in C language.
- CO7: Understand the basic concepts of file handling.
- CO8: Develop algorithmic solutions to simple computational problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1,PSO3
CO2	PO1,PO2,PO3,PO10/PSO1,PSO3
CO3	PO1,PO2,PO3,PO4/PSO1,PSO3
CO4	PO1,PO3, PO12/PSO1,PSO2
CO5	PO1,PO2,PO4 /PSO1,PSO3
CO6	PO1,PO2,PO3,PO4/PSO1,PSO2
CO7	PO1,PO3,PO6 /PSO1
CO8	PO1,PO2,PO4,PO10,PO12/PSO1,PSO3

BCSC0002: OBJECT ORIENTED PROGRAMMING

OBJECTIVE: *This course introduces the Object-Oriented programming paradigm to students. It also teaches a student how to think objectively and model a Java program for solving real-world problems.*

CREDITS: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Object-Oriented Programming:** Features of Object-Oriented Programming, Introduction to Object-Oriented Java Programming. **g Java Technology & Environment:** Understanding the compilation process of the JVM, JVM vs JDK vs JRE, Key Features of Java, Structure of a simple Java program. **Working with Java Primitive Data Types:** Strongly Typed nature of Java, Primitive Data Types in Java, The new 'var' keyword, Scope of a variable. **Accepting User Input in Java Programs:** using the Scanner class, using command line arguments. **Programming Constructs:** Sequence, Selection, Iteration & Transfer Statements, For-Each Loop. **Working with Java Arrays**: Declaring and Initializing One-Dimensional and Two-Dimensional Arrays in Java, Introduction to java. util. Arrays class. **The String API:** String Data Type, commonly used methods from the String API, StringTokenizer, StringBuilder & StringBuffer. **Creating and Using Methods:** Signature of a method, Types of Methods, Overloading methods in a class, Static and Non-Static Methods. **Describing and Using Objects & Classes:** Declare the structure of a Java class, declaring members of a class (fields and methods), declaring and using Java Objects, lifecycle of an Object (creation, assignment, dereferencing and garbage collection), Constructors of a class, Overloading Constructors, Constructor chaining using 'this' and 'super' keyword. **Using Java Packages:** create and import Java packages and static imports, abstracting program logic to packages, creating executable main class, running the executable class inside a package. **Applying Encapsulation**: Using access modifiers with/in a class, principles of encapsulation. **Programming Abstractly Through Interfaces:** create and implement Interfaces for programs, private and default methods in Interfaces, declaring Abstract Classes, Constructors in Abstract Classes. Marker Interface, Functional Interfaces, Lambda Expressions in Java.	20
II	**Reusing Implementations using Inheritance:** Declaring Subclasses and Superclasses, extend Abstract Classes, implementing Interfaces, exploring polymorphic behaviour by overriding methods, Object Types vs Reference Types, differentiate overloading, overriding and hiding. **Exception Handling:** Exception Hierarchy, Need of Exception Handling, Checked Exceptions, Unchecked Exceptions and Errors, Try-Catch Blocks, Finally, Throw & Throws Keywords, creating and handling Custom Exceptions. **Threads in Java:** Life Cycle of a Thread, creating threads using Runnable and Thread, 'sleep ()', Thread Priorities. **Using Wrapper Classes:** Wrapper Classes in Java, Boxing-Unboxing-Auto Boxing-Auto Unboxing. **Generics & Collections:** Creating Generic classes, Generic Methods, Diamond Notation, Wildcards, Type Erasure, Collection Hierarchy, Base Interfaces, Lists, Sets and Maps. **The Stream API:** Introduction to the Stream API, using lambda expressions in Streams. **Regular Expressions:** Pattern and Matcher Class. **JDBC:** JDBC Drivers, Connecting to a MySQL Database, Driver Manager, Connection Interface, Statement Interface, Result Set Interface, Prepared Statements.	18

Text Book:

- Herbert Schildt , "The Complete Reference, Java Eleventh Edition", Oracle Press. 2019.

Reference Book:

- Cay S Hosrtmann , "Core Java Volume I—Fundamentals, Eleventh Edition", Pearson, 2018.
- Rogers Cadenhead , "Sams Teach Yourself Java in 21 Days (Covers Java 11/12), 8th Edition", Pearson, 2020.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5,CO7.

Outcome: After completion of the course, students will be able to -

- CO1: Understand the basics of Object-Oriented Programming paradigm.
- CO2: Construct the logical flow of programs by using the sequence, selection, iterations and transfer statements.
- CO3: Apply the concepts of Object- Oriented Programming to model programs in Classes, Abstract Classes, Interfaces and Enums, and simplify program function by dissecting it into methods.
- CO4: Understand accessibility of members in a program unit and create packages to prevent namespace collisions.
- CO5: Predict run-time errors in a program by examining program functioning.
- CO6: Show the parallel processing capabilities of a program using a multithreading concept.
- CO7: Experiment with the predefined classes and interfaces defined in the Collections Framework.
- CO8: Develop a program using JDBC connectivity to demonstrate data persistence.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1 /PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/ PSO2
CO7	PO1,PO2,PO11/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO2

BCSC0003: DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database & NoSQL system. Students learn how to design and create a good database.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	Introduction**:** An Overview of Database Management System, Database System Vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with Case Studies. Data Modeling Using the Entity-Relationship Model**:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. Relational Data Model and Language**:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization I:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, Non-Redundant Cover, Canonical Cover **PL/SQL:** Query languages, nested queries, group by and having clause.	20
II	**Database Design & Normalization II:** 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, MVD and JDs, Inclusion Dependence. **File Organization:** Indexing, Structure of Index files and Types, Dense and Sparse Indexing **Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication.	20

Text Books:

- Elmasri and Navathe , "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler ,"NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

References Books:

- Date C J, "An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. & Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO6.

Outcome: After the completion of the course, the student will:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.

- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss indexing mechanisms for efficient retrieval of information from a database.
- CO8: Discuss recovery system and be familiar with introduction to web database, distributed databases.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1 /PSO1
CO2	PO2, PO3/ PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3,PO9/ PSO2
CO7	PO1,PO11 /PSO1
CO8	PO1,PO3,PO12/ PSO2

BCSC0004: OPERATING SYSTEMS

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Operating System and its Classification - Batch, Interactive, Multiprogramming, Time sharing, Real Time System, Multiprocessor Systems, Multithreaded Systems, System Protection, System Calls, Reentrant Kernels, Operating System Structure- Layered structure, Monolithic and Microkernel Systems, Operating System Components, Operating System Functions and Services. **Processes:** Process Concept, Process States, Process State Transition Diagram, Process Control Block (PCB), Process Scheduling Concepts, Threads and their management. **Process Synchronization:** Principle of Concurrency, Implementation of concurrency through fork/join and parbegin/parend, Inter Process Communication models, shared memory and message passing Schemes, Producer / Consumer Problem, Critical Section Problem, race condition ,two process software solution Dekker's solution, Peterson's solution, Semaphores, Synchronization Hardware. **Classical Problem in Concurrency:** Dining Philosopher Problem, Readers Writers Problem, sleeping barbar,	20
II	**Deadlock:** System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock, Combined Approach. **Memory Management:** Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation. **Virtual memory concepts:** Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Locality of reference. **I/O Management and Disk Scheduling:** I/O devices, I/O subsystems, I/O buffering, Disk storage and disk scheduling. **File System:** File concept, File organization and access mechanism, File directories, File allocation methods, Free space management.	20

Text Books:

- Silberschatz, Galvin and Gagne , "Operating Systems Concepts",9th Edition, Wiley, 2012.

Reference Books:

- Sibsankar Halder and Alex a Aravind , "Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel ,"An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the classification of operating system environment.
- CO2: Understand the basic of process management.
- CO3: Apply the concept of CPU process scheduling for the given scenarios.
- CO4: Illustrate the process synchronization and concurrency process in operating system.
- CO5: Analyze the occurrence of deadlock in operating system.
- CO6: Describe and analyze the memory management and its allocation policies.

- CO7: Understand the concepts of disk scheduling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO7/PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO4/PSO1,POS3
CO4	PO3,PO4,PO6/PSO3,PSO4
CO5	PO1,PO4/PSO1,PSO3
CO6	PO1,PO2 /PSO1,PSO3
CO7	PO1,PO2,PO7/PSO1,PSO3

BCSC0005: COMPUTER ORGANIZATION

Objective: *This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**PREAMBLE:** Subject Introduction, Basic organization of the computer and block level description of the functional units, Number Representation, Fixed and floating-point Number Representation-Arithmetic Addition/subtraction, overflow, IEEE standard for floating point representation, **Basic Computer Organization and Design:** Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description. Introduction to combinational circuit - Half Adder, Full Adder, carry look ahead adder, Multiplexor/ De multiplexer and Decoder/Encoder, Introduction to sequential circuit- Flip-Flops, Synchronous and Asynchronous Counters, Register, Bus and memory Transfer Language. **Arithmetic Operations:** Addition and subtraction of signed numbers, Hardware implementation of Method, Multiplication: Signed operand multiplication, Booths algorithm, Hardware implementation of Algorithms, Array Multiplier. **Processor Organization:** General register organization, Single Accumulator and Stack organization, Addressing Modes, Types of Computer Instructions – one, two, three & four address, Instruction Cycle, Instruction Formats.	20
II	**Micro-operations:** Arithmetic, Logical & Shift Micro operations with some applications. **Multiprogramming and Multiprocessing:** Introduction to pipelined operation. **Hardwired & Microprogrammed Unit:** Execution of a complete instruction & Branch Instructions, Hardwired control Unit, Micro programmed control Unit, Micro-Instructions, Microinstruction with Next Address field, Pre-Fetching Microinstructions, Concept of Horizontal and Vertical Microprogramming. **Memory:** Basic concept and Hierarchy, RAM memories, 2D, 2 & 1/2D Memory Organization, ROM Memories, Cache Memories: Concept and Design issues performance, Address mapping and Replacement, Auxiliary memories: Magnetic disk, Magnetic tape and Optical disks, Virtual memory: Concept and Implementation. Input/Output: Peripheral Devices, I/O interface, I/O ports. **Interrupts:** Interrupt hardware, Types of Interrupts and Exceptions, Buses, Bus architecture, Types of Buses and Bus Arbitration. Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O, Direct Memory Access, I/O channels and Processors, Standard communication interfaces.	**20**

Text Books:

- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4th **Edition**, Elsevier Publication, 2008.
- William Stalling , "Computer Organization",8th Edition, PHI, 2011.
- V. CarlHamacher, Zaky , "Computer Organization",4th International Edition, TMH, 1996.
- John P Hays, "Computer Organization", 2nd Edition, TMH.
- Tannenbaum , "Structured Computer Organization", 5th Edition, PHI, 2005.
- P Pal Chaudhry , "Computer Organization & Design", 2nd Edition, PHI, 2002.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO7.

Outcome: After completion of the course, the student will be able to:

- CO1: Understand the basics of digital computer system.
- CO2: Demonstrate the principle of arithmetic operations on unsigned, signed integers and floating point numbers.
- CO3: Understand the concepts of Combinational and Sequential circuits and their applications.
- CO4: Understand the CPU architecture and organization.
- CO5: Explain the basic concepts of pipelining.
- CO6: Design the steps for the execution of the complete instruction for hardwired and micro-programmed control unit.
- CO7: Explain the function of memory hierarchy.
- CO8: Determine the interface of CPU with input/output devices and their modes of transfer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1
CO2	PO1,PO3/PSO1
CO3	PO2,PO3,PO5/PSO2
CO4	PO2,PO3,PO4/PSO1,PSO3
CO5	PO2,PO3,PO4/PSO2
CO6	PO1,PO2,PO3/PSO1,PSO3
CO7	PO2,PO3,PO5/PSO2,PSO3
CO8	PO3,PO4/PSO1

BCSC0006: DATA STRUCTURES AND ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs*.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Terminology, Elementary Data Organization, Properties of an Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic Notations – Big-Oh; Operations on Data Structure, Abstract Data Types (ADT). **Linked Lists:** Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Generalized Linked List, Polynomial Representation and Addition. **Stacks:** Primitive Stack Operations **-** Push & Pop, Array and Linked Implementation of Stack in C, Application of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of Infix to Postfix expression, Recursion, Principles of Recursion, Tail Recursion, Removal of Recursion, use of stack in Recursion, Tower of Hanoi Problem. **Queues:** Operations on Queue **-** Add, Delete operations, Implementation of Queue Using Array and Linked List, Circular Queues, Deque and Priority Queue. **Trees:** Basic Terminology, Array Representation and Dynamic Representation; Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Tree Traversal Algorithms **-** Inorder, Preorder and Postorder; Threaded Binary Trees, Traversing Threaded Binary Trees.	20
II	**Search Trees:** Binary Search Trees (BST), Insertion and Deletion in BST, AVL Trees, Introduction to M-Way Search Trees, B Trees. Threaded binary trees, Priority Queues –Definition and applications, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, and Deletion from a Max Heap. **Searching:** Sequential Search, Binary Search. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Two Way Merge Sort, and Heap Sort. **Graphs:** Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees – Prim's and Kruskal's Algorithm; Shortest Path Algorithm – Bellman-Ford and Dijkstra's Algorithm. **Hashing & Indexing:** Hash Function, Collision Resolution Strategies. Primary Indices, Secondary Indices, Indexing and Hashing Comparisons.	20

Text Book:

- Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein (), "*Data Structures Using C and C++*", 2nd Edition, PHI, 2009.

Reference Books:

- Horowitz and Sahani , "*Fundamentals of Data Structures*", 3rd Edition, W H Freeman & Co, 2004-05.
- Jean Paul Trembley and Paul G. Sorenson , "*An Introduction to Data Structures with Applications*", 2nd Edition, TMH, 2007.
- R. Kruse, "*Data Structures and Program Design in C*" , 2nd Edition, Pearson Education, 2004.
- Lipschutz Schaum's Outline Series , *"Data Structures"*, 12th Reprint, TMH, 2010.
- G A V Pai , "*Data Structures and Algorithms",* TMH, 2009.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO7.

Outcome: After completion of course, student will be able to:

- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2
CO3	PO1/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4/PSO3
CO6	PO2/PSO4
CO7	PO2/PSO4

BCSC0007: INTRODUCTION TO MICROPROCESSORS

Objective: *Objective of this subject is to introduce the basic concepts of microprocessor and assembly language programming. Identify and explain the operation of the components of typical microprocessor: the role of the ALU, registers, stack and the use of interrupts.*

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Microprocessors Evolution and Types, Basics of Pentium Microprocessor, Microprocessor Application, **8-Bit Microprocessor:**8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction Set - Data Transfer Operation, Arithmetic Operation, Logic Operations and Branch Operations; Introduction to Assembly Language Program. **Programming Technique with Additional Instruction**: Looping, Counting, Indexing, Additional Data Transfer and 16-Bit Arithmetic Instruction, Counters and Time Delays, Stack and Subroutine.	20
II	**16 Bit Microprocessor:** Architecture of 8086 – Register Organization, Execution Unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities. **Peripheral Interfacing:** I/O Programming, Programmed I/O, Interrupt Driven I/O, DMA I/O, Memory-Mapped I/Os. **Peripheral Devices:** 8237 DMA Controller, 8255 Programmable Peripheral Interface, 8253/8254 Programmable Timer/Counter, 8259 Programmable Interrupt Controller.	18

Text Books:

- N Senthil Kumar, M Saravanan, and S Jeevananthan , “Microprocessors and Microcontrollers”, Oxford University Press India, 2010.

Reference Books:

- Ramesh S. Gaonkar , “Microprocessor Architecture Programming and Applications with 8085”, 4th Edition, Penram International Publishing, 2000.
- Ray A.K. Bhurchandi.K.M , “Advanced Microprocessor and Peripherals”, TMH, 2002.
- D. V. Hall , “Microprocessors and Interfacing: Programming and Hardware”, 2nd Edition, TMH, 1992.
- Y.C. Liu and G.A. Gibson , “Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design”, 2nd Edition, PHI, 2003.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Demonstrate the Microprocessor internal architecture and its operations.
- CO2: Develop programs based on 8085 microprocessor instruction set and addressing mode.
- CO3: Develop program using looping, counting, indexing, counter and time delays.
- CO4: Understand the concept of stack and subroutine for modular approach.
- CO5: Compare accepted standards and guidelines to select microprocessor (8085 & 8086) to meet performance requirements.
- CO6: Analyze the concept of interfacing the processor to external device with I/O programming & Interrupt Driven I/O.
- CO7: Understand the working of interfacing chips (8237, 8253/54, 8255 & 8259).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1,PSO2
CO3	PO2,PO3/PSO1,PSO2
CO4	PO1,PO2,PO3/PSO1,PSO3
CO5	PO2,PO3,PO5/PSO1,PSO3
CO6	PO1,PO2/PSO3
CO7	PO1,PO2,PO4/PSO3

BCSC 0008: Computer Networks

Objective: *The objective is to understand fundamental underlying principles of computer networking, details and functionality of layered network architecture.*

Credits: 03 **Semester - IV** **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Network Software:** Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Services, Service Primitives, The Relationship of Services to Protocols. Reference Models: The OSI Reference Model, The TCP/IP Reference Model. Example Networks: The Internet, Connection-Oriented Networks (X.25, Frame Relay & ATM), Ethernet. **Introduction Concepts**: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design, Physical Layer Transmission Media, Line coding scheme, switching methods (circuit switching, Packet switching), TDM. **Medium Access sub layer**: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols, CSMA, CSMA/CD, Overview of IEEE standards.	20
II	**Data Link Layer**: Error detection and correction, Flow control (sliding window protocol) **Network Layer**: Network Layer –IP addressing, subnet, CIDR, VLSM, Internetworking, Address mapping, routing. Connecting devices. **Transport Layer**: Transport Layer - Design issues, connection management, Flow control, TCP window management, congestion control-slow start algorithm. **Application Layer**: Data compression, Data Encryption, File Transfer, DNS, HTTP, SMTP, TELNET **Introduction to IPv6, transition from IPv4 to IPv6.**	20

Text Books:

• Forouzan B. A. , "Data Communication and Networking", 4th Edition, McGrawHill, 2004.

References:

• Kurose, J.F. and Ross K.W. , "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Addison-Wesley, 2005.
• A.S. Tanenbaum , "Computer Networks", 2nd Edition, Prentice Hall India, 2006.

Focus: This Course focuses on Employability under CO1,CO2,CO4,CO5.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the concept of OSI and TCP/IP reference model.
- CO2: Understand the basics of data transmission at physical layer.
- CO3: Understand the channel allocation using ALOHA, CSMA and CSMA/CD.
- CO4: Apply error detection and correction technique to eliminate transmission error.
- CO5: Analyze the fixed and variable length address (IPv4) subneting for the given scenarios.
- CO6: Understand the design issues of the transport layer.
- CO7: Understand the mechanism of protocols at application layer such as FTP, HTTP, Telnet, DNS.
- CO8: Understand IPv6 addressing and differentiate it from IPv4.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs

CO1	PO1,PO3,PO12/PSO1
CO2	PO1/PSO2
CO3	PO1,PO4/PSO1,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO3,PO4,PO6/PSO3
CO6	PO2,PO4/PSO1
CO7	PO5,PO12/PSO2
CO8	PO4,PO7/PSO4

BCSC0009: SOFTWARE ENGINEERING

Objective: *Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility.*

L–T–P-J: 3–0–0-0

Credits: 03

Module No.	Content	Teaching Hours
I	**Introductory Concepts**: The evolving role of software – characteristics, components and applications. **A Generic view of process:** Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. **Process Models:** Waterfall Model, Prototyping, Incremental, Spiral. **Agile software Development**: Introduction to Agile, Agile software development framework. **Software Requirement Specification**: Requirement Process, SRS Components, Requirement Specifications with Use Cases Diagram. **Software Project Planning:** Project Planning Objectives. **Software Metrics:** Size, Function Point, Staffing, Project Estimation Methods– COCOMO Model. **Function-Oriented Design**: Problem Partitioning, Abstraction, Top Down and Bottom Up Design. **Module-Level Concepts:** Coupling, Cohesion, Design Notation and Specification - Structure Charts; Structured Design Methodology - Data Flow Diagram, Sequence Diagram.	20
II	**OO Analysis and OO Design:** OO Concepts, Introduction to UML Design Patterns: Class Diagram, Activity Diagram, State Chart Diagram. **Coding**: Coding Process, Verification – Code Inspections, Software Metrics. **Testing Fundamentals**: Test Case Design, Black Box Testing Strategies, White Box Testing, Unit Testing, Integration Testing, System Testing. **Introduction to Automation Testing and Testing Tools:** Automated Testing Process, Framework for Automation Testing, Introduction to Automation Testing Tool. **Software Quality:** Models, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model. **Software Maintenance**: Models Cost of Maintenance, Re-engineering, Reverse Engineering.	18

Text Books:

- R. S. Pressman , "Software Engineering: A Practitioners Approach", 7thEdition, McGraw Hill, 2010.

Reference Books:

- K. K. Aggarwal and Yogesh Singh , "Software Engineering", 3rd Edition, New Age International Publishers, 2008.
- Rajib Mall , "Fundamentals of Software Engineering", 3rd Edition, PHI Publication, 2009.
- R.E Fairley , "Software Engineering", McGraw Hill, 2004.
- Sommerville , "Software Engineering", 9th Edition, Pearson Education, 2010.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO4.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of software engineering.
- CO2: Apply software processes to solve real world problems.

- CO3: Estimate the cost, effort and schedule of software using COCOMO Model.
- CO4: Analyze the software design techniques (structure chart, SDM, sequence diagram).
- CO5: Understand the basic concepts of OO analysis and design.
- CO6: Develop the test cases to validate the software.
- CO7: Understand the basic models of software Quality and maintenance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO7/PSO1
CO2	PO2,PO3/PSO4
CO3	PO2,PO11/PSO3
CO4	PO3,PO10/PSO4
CO5	PO3,PO7/PSO1
CO6	PO5,PO12/PSO2
CO7	PO4,PO9,PO12/PSO1

BCSC0010: DISCRETE MATHEMATICS

Objective: *The objective is to introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in computer science.*

Credits: 4 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Sets, Relations and Functions:** Introduction to Set Theory, Venn diagrams, algebra of Sets, Inclusion-Exclusion Principle, Partitions, Proof Techniques, Relations, Properties and their types, Function and their types. Recurrence Relations and Generating Functions **Introduction to Counting Principle**: Permutation, Combination, Permutation with Repetition, Combination with Repetition, Pigeonhole Principle. **Probability Theory**: Introduction to Probability Theory, Conditional Probability, Total Probability, Bayes' Theorem.	20
II	**Propositional Logic -** Logical Connectives, Truth Tables, Normal Forms (Conjunctive and Disjunctive), Validity; **Predicate Logic -** Quantifiers, Inference Theory, Methods of Proof: Direct, Indirect, Mathematical Induction. **Algebra**: Motivation of Algebraic Structures, Finite Groups, Subgroups and Group Homomorphism; Lagrange's Theorem; Commutative Rings and Elementary Properties; **Graph Theory:** Introduction to Graphs, Types: Planner, Directed, Complete, Bipartite Graph, Isomorphism , Euler Graph, Hamiltonian Graph, Operations on Graphs, Representation of graphs, Connectivity.	20

Text Book:

- Kenneth H Rosen , "Discrete Mathematics and Its Applications", 7th edition, TMH, 2012.

Reference Books:

- J.P. Tremblay , "Discrete Mathematical Structures with Applications to Computer Science", TMH, New Delhi, 1997.
- V. Krishnamurthy , "Combinatorics: Theory and Applications", East-West Press, New Delhi, 1986.
- Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics- An Applied Introduction", 5th Edition, Pearson Education, 2004.
- C.L. Liu , "Elements of Discrete Mathematics", 2nd Edition, TMH, 2000.

Focus: This Course focuses on Employability under CO1,CO2,CO5,CO8.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the notion of mathematical thinking and proofs to solve the problem.
- CO2: Apply the basics of discrete probability and number theory to solve the real world problem. CO3: Analyze basic discrete structures and algorithms using effectively algebraic techniques.
- CO4: Analyze mathematical concepts like sets, reasoning, relational algebra and graph theory to solve optimization problems.
- CO5. Analyze the validity of an argument using logical notation.
- CO6. Demonstrate the basic structures of proof techniques to write and evaluate the validity of arguments.
- CO7. Understand the basic principles of sets, set equalities and operations in sets.
- CO8. Apply counting principles to determine probabilities.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO3
CO2	PO1,PO3/PSO4
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3
CO5	PO1,PO2/ PSO3
CO6	PO1,PO3/PSO2,PSO3
CO7	PO1,PO2/PSO1
CO8	PO1,PO3/PSO1,PSO4

BCSC0011: THEORY OF AUTOMATA & FORMAL LANGUAGES

Objective: *The objective of this course is that students will study and compare different models and views of the abstract notion of computation and its various aspects.*

Credits:04 **Semester V** **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem; FA with Output - Moore and Mealy machine, Applications and Limitations of FA. **Regular expression (RE):** Regular Expression to FA, DFA to Regular Expression, Arden Theorem, Non Regular Languages, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages. **Push Down Automata (PDA):** Introduction, Language of PDA, Acceptance by Final State, Acceptance by Empty Stack, Deterministic PDA.	20
II	**Context Free Grammar (CFG) and Context Free Languages (CFL):** Introduction, Derivation Trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Simplification of CFGs, Normal Forms for CFGs - CNF and GNF; Pumping lemma for CFLs, Equivalence of PDA and CFG. **Turing machines (TM):** Basic Model, Definition and Representation, Variants of Turing Machine and their equivalence, TM for Computing Integer Functions, Universal TM, Church's Thesis, Recursive and Recursively Enumerable Languages, Halting Problem, Introduction to Computational Complexity. **Decidability:** Post's Correspondence Problem (PCP), Rice's Theorem, Decidability of Membership, Emptiness and Equivalence Problems of Languages.	20

Text Books:

- K.L.P. Mishra and N. Chandrasekaran , "Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI, 2006.

Reference Books:

- Hopcroft, Ullman , "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2013.
- Martin J. C ," Introduction to Languages and Theory of Computations", 4th Edition, TMH, 2011.

Focus: This Course focuses on Employability under CO1,CO2,CO6.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts of Context Free languages, Expression and Grammars.
- CO2: Analyze the conversion of NFA to DFA, Mealy to Moore and Moore to Mealy.
- CO3: Analyze the process to convert regular expression to DFA, DFA to regular expression, and minimization of DFA.
- CO4: Develop the PDA for the context free language and context free grammar.
- CO5: Analyze that the grammar is ambiguous or unambiguous.
- CO6: Apply the process to convert CFG to CNF and GNF.
- CO7: Understand the concept of Turing machine and its variants.
- CO8: Design the Turing machine for the real world application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO1,PSO4
CO2	PO2,PO3/PSO3
CO3	PO2,PO3,PO9,PO12/PSO1,PSO3,PSO4
CO4	PO1,PO3,PO5,PO9/PSO3,PSO4
CO5	PO1,PO2,PO4/PSO3
CO6	PO2,PO3/PSO3
CO7	PO1,PO2/PSO1,PSO3
CO8	PO3,PO12/PSO1,PSO2,PSO3

BCSC0012: DESIGN & ANALYSIS OF ALGORITHMS

Objective: *The objective of this course is that students will construct and application of various data structures and concepts including Trees, Recursion & Dynamic programing.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Algorithms, analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Sorting and order Statistics - Shell sort, Quick sort, Merge sort, Heap sort, Comparison of sorting algorithms, Sorting in linear time. **Advanced Data Structures:** Red-Black trees, B – trees, Binomial Heaps, Fibonacci Heaps. Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching.	20
II	Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets Dynamic programming with examples such as Knapsack. All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem	20

Text Books:

- Thomas H. Coremen, Charles E. Leiserson and Ronald L. Rivest, Introduction to Algorithms, Third edition, Prentice Hall of India, 2008.

Reference Books:

- Gilles Brassard Paul Bratley ," Fundamentals of Algorithms", Prentice Hall, 1996.
- Ellis Horowitz, SartajSahni, SanguthevarRajasekaran , "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd, 2008.
- Levitin , "An Introduction to Design and Analysis of Algorithms", Pearson, 2008.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Understanding of complexity representation in terms of Big Oh, Theta and Omega notations.
- CO2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms (quick sort and merge sort).
- CO3: Compare and analyze different data structures (RB Tree, B Tree, Binomial Heaps, Fibonacci Heaps).
- CO4: Understand the major graph algorithms (DFS, BFS, Dijkstra's Bellman Ford) and their analyses.
- CO5: Understand the greedy paradigm and able to analyze when an algorithmic design situation calls for it. Synthesize greedy algorithms (Optimal Reliability Allocation, Minimum Spanning Trees, factorial Knapsack) and analyze them.

- CO6: Synthesize dynamic-programming algorithms (0/1 knapsack problem, Resource allocation problem, Warshal's and Floyd's algorithms) and analyze them.
- CO7: Understand the backtracking paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize backtracking algorithms (N Queen Problem, TSP Problem, sum of subsets problem, Graph Coloring) and analyze them.
- CO8: Understand the branch and bound paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize branch and bound algorithms (N Queen Problem, TSP Problem, Hamiltonian Cycles, Graph Coloring) and analyze them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4,PO12/PSO1,PSO3
CO2	PO1, PO3,PO4,PO5/PSO1,PSO3
CO3	PO1,PO3, PO6/PSO1,PSO3
CO4	PO1,PO2,PO3, /PSO1,PSO3
CO5	PO1,PO2 /PSO1,PSO3
CO6	PO1,PO2,PO3, PO6/PSO1,PSO3
CO7	PO1,,PO4,PO12/PSO1,PSO3
CO8	PO1,PO2,PO3,PO4,PO12/PSO1,PSO2

BCSC0604: INTRODUCTION TO INTERNET OF THINGS

Objective: *The objective of this course is to give the basics of IoT Technology, Data and Knowledge Management and use of Devices in IoT Technology.*

Credits: 02 **Semester - I** **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to IoT concept, Objective, IoT History , Introduction to IoT communication, Why IoT, IoT Architecture, Telemetry Vs IoT, IoT Technologies behind smart & Intelligence devices, IoT Application: Home Automation, Health monitoring system, Smart Transportation and Smart Shopping. **Introduction IoT Hardware/Devices:** Basics Of Microcontroller, Microprocessor Vs Microcontroller, Types of Sensor, actuators and their application, Programming Fundamentals(C Programming).	15
II	Introduction to Arduino microcontroller, hands on Arduino, Arduino board layout and LED Blinking temperature sensor application. **Basics of Networking/Communication Protocol:** Types of IoT Network and topology, Communication protocol-MQTT, Introduction to cloud services-Blynk. Introduction to IoT security	15

Text Books:

- Introduction to Open Source Software & Open Standards (IBM ICE Publication)

Reference Books:

- "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)
- "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
- "Getting Started With The Internet Of Things: Connecting Sensors and Microcontrollers to the Cloud" By CunoPfister (O REILLY).

Focus: This Course focuses on Employability under CO1,CO3,CO5.

Outcome: After completion of the course, the student will be able to:

- CO1: Understand IoT Concepts.
- CO2: Understand IoT technologies behind intelligent and smart devices.
- CO3: Implement different types of sensors for receiving the real-time data.
- CO4: Evaluate received data using Arduino Uno.
- CO5: Implement the applications (Home Automation systems ect) using sensors and Arduino Uno.
- CO6: Understand basics of IoT security.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO3,PO5/PSO4
CO4	PO2/PSO3
CO5	PO3,PO5/PSO4
CO6	PO1/PSO1

BCSC0605:SENDOR TECHNOLOGY & INSTRUMENTATION

Objective: This course introduces the various types of sensors, technology, and their applications, also introduces the methods of interfacing sensors to IoT Based systems.

Credits: 03 | **Semester II** | **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Sensors:** About sensor, Properties Of Sensors Basic physical principles of sensing, Categorization Of Sensor Various effects in sensing, Temperature and thermal properties of materials, Types of temperature sensor, Dynamic Models of Sensor Elements, Mechanical Elements, Thermal Elements, Electrical Elements **Sensor Technologies:** Capacitive Sensor and Hall effect sensors, Analog-to-digital converters, A-to-D Conversion Methods "Integrating (Dual Slope) ADC", Noise in sensors, Low-power sensors, Powering Sensors, Batteries for Low-Power Sensors **Type and Application of Different Sensors**: Sensors, Classification of sensors, Different Types of sensors, Need of sensors, Motion Detectors, Occupancy Detectors, Force Sensors, Strain Sensors, Tactile sensors, Pressure sensors, Chemical sensors	20
II	**Actuators**: Introduction to actuators, Types of Actuator, Electromagnetic, Electromagnetic Force, Solenoid, Voice Coil, DC Motor, AC Motor **Communication Protocol:** CoAP, SMCP, SMTP, HTTP, HTTPS, MQTT, MQTT-S **Introduction to Data Acquisition in Sensors:**, DAQ device, Key Measurement Components of a DAQ Device, Computer Bus, Introduction to SCADA systems, SCADA Architectures, Functions of SCADA, Real-Time Monitoring and Control using SCADA, Objective of SCADA, Benefits of SCADA, Applications of SCADA, Scheduling, Classification of scheduling, On-line Scheduling, Fixed versus Dynamic Priority Algorithms, Rate-Monotonic, Deadline-monotonic priority, Dynamic Priority Algorithms	20

Text Books:

- Sensor Instrumentation & Technology, Edition 1.0, May 2018, IBM Corporation.

Reference Books:

- Advanced Sensor and Detection Materials, Editor(s): Ashutosh Tiwari Mustafa M. Demir, Scrivener Publishing
- Smart Actuators and Smart Sensors Bob Tucker NY Research Press

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of the course, the student will be able to:

- CO1: Explain sensor mechanism for converting physical parameters into electrical or mechanical parameters.
- CO2: Apply standards and guidelines to make sensitive measurements of physical parameters like pressure, flow and acceleration.
- CO3: Design optical sensors using different methods.
- CO4: Evaluate different types of sensors used in case studies.
- CO5: Analyze the different types of sensors used in real life applications.
- CO6: Development the solutions for sensors.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3/PSO2
CO2	PO1,PO5/PSO1
CO3	PO2/PSO2
CO4	PO3/PSO3
CO5	PO1/PSO3
CO6	PO2/PSO2
CO7	PO5,PO6/PSO3

BCSG0800: PYTHON PROGRAMMING LAB

Objective: *This course introduces the solving of problems using Python programming using OO concepts and its connectivity with database.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	Programs based on the concepts of: • Building Python Modules • Obtaining user Data • Printing desired output Programs based on the concepts of: • Conditional if statements • Nested if statements • Using else if and elif Programs based on the concepts of Iteration using different kinds of loops Usage of Data Structures • Strings • Lists • Tuples • Sets • Dictionary Program based on the concepts of User-defined modules and Standard Library (random, numpy, scipy, sys, Math Module, String Module, List Module). Program based on Input Output. Program based on exception Handling. Program based on Simple Data analysis. Program based on Pandas.	26

Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2, CO3.

Outcome: By the end of the course, students will learn to:

- CO1: Apply OO concepts using Python programming.
- CO2: Apply in-built packages defined in Python.
- CO3: Apply front-end as Python Programming to connect with any back-end.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO4
CO3	PO5/PSO2

BCSC0800: COMPUTER PROGRAMMING LAB

Objective: *The objective is to provide a comprehensive study of the C programming language. It stress the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	• Mapping of flow chart, Algorithm, Language • Simple C-program execution • Programs based on various operators • Programs based on Decision and case Control Structure • Programs based on Loop Control Structure • Program based on special control statement ➢ break ➢ continue • Programs based on Array Insertion, Deletion, Linear Search & Bubble Sort • Programs based on String ➢ Length, Copy, Reverse, Concatenate, Compare with & without built-in functions • Programs based on Functions. • Programs based on Storage Class. • Programs based on Recursion. • Programs based on Preprocessor. • Programs based on Pointers • Programs based on array • Programs based on string • Programs based on call by value and call by reference • Programs based on Dynamic Memory Allocation • Programs based on User Defined Data types ➢ Structure and Union ➢ Enum and Typedef • Programs based on File handling ➢ Opening a file ➢ Reading, writing and appending a file ➢ Closing file ➢ Random Access to Files of Records • Programs based on Command Line Argument.	52

Reference Books:

- Herbert Schildt, “C: The Complete Reference”, 5th Edition, McGraw Hill Education
- K. N. King, “C Programming a Modern Approach”, W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, “The C Programming Language”, PHI, 2ndEdition, 2011.
- P. Dey and M. Ghosh, “Programming in C”, Oxford University Press 2nd Edition, 2013.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: On Completion of this course, students are able to:

- CO1: Design programs involving decision structures, loops and functions.
- CO2: Understand the concepts of functions, recursion, pointers and file handling.
- CO3: Design programs involving structures, union and functions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO3,PO4/PSO1
CO3	PO3/PSO2,PSO4

BCSC0801: OBJECT ORIENTED PROGRAMMING LAB

Objective: *The objective of this course is that students will study and learn Object Oriented Modeling and programming.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	Programs in Java and python based on the concepts of: • Classes, Constructors, Polymorphism and Keyword Static. Programs based on the concepts of: • Inheritance, Multithreading Using Thread Class & Interface Runnable, String Handling, Generic Classes. Programs based on the concepts of: • Handling Database Connectivity. • Implementation of Collection Framework. Programs based on the concepts of: • Database Connectivity. • Retrieving Data from Database. • Parameters Passing, Execute many Method. • Cursor Attributes. • Invoke Stored Procedures. • Invoke Stored Functions.	24

Reference Books:

- Naughton, Schildt, "The Complete Reference JAVA2", 9th Edition, Oracle Press.
- Bhave & Patekar, "Programming with Java", Pearson Education
- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome: After completion of course, the student will be able to:

- CO1: Implement object oriented language features.
- CO2: Design GUIs and Graphical programming.
- CO3: Design object oriented solutions for small systems involving database and event handling concepts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO3,PO5/PSO2
CO3	PO3,PO5/PSO4

BCSC0802: DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Generation of database report,.	24

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998
- Majumdar& Bhattacharya, "Database Management System", TMH

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Develop the SQL queries for real life scenarios.
- CO3: Implement the procedural language (PL/SQL) and Triggers.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO1,PO2/PSO1,PSO4
CO3	PO2,PO3,PO5/PSO2,PSO3

BCSC0803: OPERATING SYSTEMS LAB

Objective: *The lab aims to develop understanding the operation of UNIX operating system.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implement the following basic commands (with options) used in UNIX/LINUX OS. • Write and implement the basic vi editor commands. • Shell scripts that use simple commands. • Decision based Shell scripts. • Shell scripts related to strings. • Shell scripts using pipes. • Shell scripts with loop statements. • Demonstration and solution for race condition. • Demonstration and use of System Calls. • Implement the basics of IPC in UNIX. • Implementation of Classical Problem in Concurrency	24

Reference Books:

- SibsankarHalder and Alex a Aravind ," Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel , "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhere , "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach. , "Design of the Unix Operating System", PHI, 1986.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, the student will be able to:

- CO1: Implement the basic operations on UNIX operating systems.
- CO2: Demonstrate the working of systems calls.
- CO3: Demonstrate message passing in Unix operating system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO4/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO4,PO5/PSO1,PSO2

BCSC0804: COMPUTER ORGANIZATION LAB

Objective: *The aim of the lab is to better understand the design of sequential Circuits such as Flip-Flops, Registers, and Counters.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• Bread Board Implementation of Flip-Flops. • Experiments with clocked Flip-Flops. • Design of Counters. • Bread Board implementation of Counters &Shift Registers. • Implementation of Arithmetic Algorithms. • Bread Board implementation of Adder/Subtraction (Half, Full). • Bread Board implementation of Binary Adder. • Bread Board implementation of Seven Segment Display. • Small Project based on combinational and sequential circuit. • Verify the excitation tables of various FLIP-FLOPS . • Design of an 8-bit ARITHMETIC LOGIC UNIT. • Design of 24x8 (16 byte) RAM. • Design of 24x8 (16 byte) STACK. . Implementation of a 4-bit PROCESSOR.	24

Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4th edition, Elsevier Publication, 2008.
- William Stalling , "Computer Organization",8th Edition, PHI, 2011.
- M. Mano , "Computer System Architecture", 3rd Edition, PHI, 1996.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Implement the Combinational and Sequential Circuit.
- CO2: Demonstrate the working of counter and shift register.
- CO3: Demonstrate the working of ALU and seven segment displays.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO5/PSO2
CO2	PO3,PO4/PSO2
CO3	PO3,PO5/PSO1,PSO2

BCSC0805: DATA STRUCTURES & ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module		Lab
I &II	• Program to implement various operations in a singly linked list. • Program to implement insertion, deletion and traversal in a doubly linked List. • Program to implement polynomial addition using linked list. • Program to demonstrate the various operations on stack. • Program to convert an infix expression into postfix expression. • Program to evaluate a given postfix expression. • Program to implement Tower of Hanoi problem using Recursion. • Program to demonstrate the implementation of various operations on linear and circular queue. • Program to demonstrate the implementation of insertion and traversals on a binary search tree. • Program to implement Dijkstra's Algorithm to find the shortest path between source and destination. • Program to search a given element as entered by the user using sequential and binary search to search a given element as entered by the user. • Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort. • To write the following recursive functions for a singly-linked NULL-terminated list: insert(), traverse(), search().	24

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

BCSC0806: MICROPROCESSORS LAB

Objective: *The objective is to introduce the Architecture and programming of the microprocessor and learning about interfacing and various applications of microprocessor.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I & II	• To study 8085 microprocessor System. • To study 8086 microprocessor System. • To develop and run basic programs in 8085 ALP. • To develop and run programs in 8085 ALP related to the concept of looping, counting and indexing. • To perform interfacing of RAM chip to 8085/8086. • To perform interfacing of keyboard controller. • To perform interfacing of DMA controller. • To perform interfacing of UART/USART.	24

Reference Books:

- Ramesh S. Gaonkar , "Microprocessor Architecture Programming and Applications with 8085", 4th Edition, Penram International Publishing, 2000.
- D. V. Hall , "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, TMH, 1992.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the arithmetic and logical operations using assembly language programming (8085).
- CO2: Demonstrate the memory operations using assembly language programming (8085).
- CO3: Demonstrate the interfacing of Keyboard, DMA and UART controller.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO2/PSO1,PSO2
CO3	PO1,PO3,PO5/ PSO2

BCSC0807: DESIGN & ANALYSIS OF ALGORITHMS LAB

Objective: *The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Implementation of sorting algorithms: ○ Insertion Sort ○ Bubble Sort ○ Selection Sort ○ Divide and conquer approach: • Quick Sort • Merge Sort ○ Heap Sort ○ Counting Sort • Implementation of Searching Techniques: ○ Linear Search ○ Binary Search • Implementation of Matrix Multiplication • Implementation of Convex Hull • Implementation of Breadth First Search • Implementation of Depth First Search • Implementation of Greedy approaches: ○ Optimal Reliability Allocation. ○ Knapsack. Minimum ○ Minimum Spanning trees: • Prim's and Kruskal's algorithms. ○ Single source shortest paths – • Dijkstra's and Bellman Ford algorithms. • Implementation of Dynamic Programming: ○ Longest Increasing Subsequence. ○ Finding best path in maze. ○ Matrix Chain Multiplication ○ 0/1 Knapsack Problem ○ Resource Allocation Problem	32

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.
- CO2: Demonstrate and use the appropriate data structures for a given problem
- CO3: Implement the algorithms based on Greedy approach and Dynamic Programming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2,PO4/PSO1,PSO2,PSO4
CO2	PO1,PO3,PO4/PSO1,PSO2,PSO3
CO3	PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0902: SENSOR TECHNOLOGY & INSTRUMENTATION LAB

Objective: The objective of this course is to aware of different types of sensors.

Credits: 01 **Semester II** **L–T–P-J: 0–0-2-0**

Module No.	Content	Teaching Hours
I&II	1. Demonstrate: Ohms law, Kirchhoff's law, Thermoelectric Effects, See-back Effect, Pettier Effect, Thomson Effect and Piezoelectric Effect. 2. WAP to interface and blink the LED using Arduino UNO. 3. WAP to interface for different sensors (Like DHT11, temperature, IR, Ultrasonic etc) to Arduino UNO. 4. WAP to interface temperature sensor to ESP8266. Turn on the LED if temperature value met threshold value. 5. WAP to transmit data wirelessly using multi-hop method. 6. Write a python program for Gateway to store sensor data on local MySQL database. 7. WAP to transmit the data wirelessly for longer distance using multi-hop technique. 8. Configure the gateway as local MQTT broker (Mosquitto), configure one ESP8266 as sender (Publisher), and receive the data on the Smartphone (MQTT Dashboard).	24

Text Books:

- "Sensor Technology and Instrumentation", by IBM – ICE(Innovation centre for Education)

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome:

- CO1: Apply the concepts of sensor technologies in different application.
- CO2: Understand the functionality of system components/devices for the automation of processes.
- CO3: Apply the concepts of instruments and sensors for measuring velocity and acceleration.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO2
CO3	PO1,PO3/PSO2

BCSC0014: APPLIED DATABASE MANAGEMENT SYSTEM

Objective: *The objective of the course is to enable students to understand and use a relational database& NoSQL system. Students learn how to design and create a good database.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with case studies. **Data Modeling Using the Entity-Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model. **Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra **Database Design & Normalization:** Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, 4th Normal Form, 5th Normal Form, Lossless Join Decompositions, Non Redundant Cover, Canonical Cover, MVD and JDs, Inclusion Dependence.	26
II	**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol. **Distributed Database:** Introduction of Distributed Database, Data Fragmentation and Replication. **NoSQL System:** RDBMS vs NoSQL, BASE properties, Key-value, Columnar, Document and Graph-Based database, Introduction of MongoDB, Cassandra, Neo4j and Riak. **Database Programming using Python**: Database connectivity, Retrieving Data from Database, Parameters Passing, Executemany Methods, Cursor Attributes, Invoke Stored Procedures, Invoke Stored Functions.	26

Text Books:

- Elmasri and Navathe , "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler , "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

References Books:

- Date C J," An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. &Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

Focus: This Course focuses on Employability under CO1,CO2,CO6,CO8.

Outcome: After completion of course, student will be able to:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.

- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.
- CO6: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO7: Discuss recovery system and be familiar with introduction to web database, distributed databases.
- CO8: Explain the differences between RDBMS and No-SQL,BASE properties and No-SQL databases.
- CO9: Design and implement the database system with the fundamental concepts of DBMS using Python.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2,PO3/PSO2
CO3	PO2,PO3,PO6,PO11/PSO1,PSO1,PSO2,PSO4
CO4	PO1,PO3/PSO1
CO5	PO1,PO5/PSO1
CO6	PO2,PO3/PSO2
CO7	PO1,PO3/PSO2
CO8	PO1,PO2,PO3/PSO1,PSO4
CO9	PO1,PO2,PO3,PO5/PSO1,PSO2,PSO4

BCSC0808: APPLIED DATABASE MANAGEMENT SYSTEM LAB

Objective: *The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL and NoSQL databases.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	• Write the SQL queries for data definition and data manipulation language. • To implement various operations on a table. • To implement various functions in SQL. • To implement restrictions on the table. • To implement the concept of the grouping of Data. • To implement the concept of Joins in SQL. • To implement the concept of sub-queries. • To implement the concept of views, sequence. • To implement the concept of PL/SQL using a cursor. • To implement the concept of Procedure function and Triggers. • Introduction to MongoDB and its Installation on Windows or Linux, Description of mongo Shell, create database and show database, Commands for MongoDB and To study operations in MongoDB – Insert, Query, Update, Delete and Projection • To implement Database connectivity using Python	24

References Books:

- Date C J,” An Introduction to Database Systems”, 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan , “Database Concepts”, 5th Edition, TMH, 1998.
- Majumdar & Bhattacharya, “Database Management System”, TMH
- Sadalage, P. & Fowler , “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Implement the procedural language (PL/SQL) and Triggers.
- CO3: Apply NoSQL queries in MongoDB.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO2,PO3,PO5/PSO2,PSO3
CO3	PO5/PSO2

Program Elective (Only for IBM Programme)

S. NO.	SEMESTER	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Internet of Things(IoT)									
THEORY									
1.	BCSE0651	Wireless Sensor Networks &IoT Standards	3	0	0	0	3	3	
2.	BCSE0652	Cloud Architecture and Deployment Models	3	0	0	0	3	3	
3.	BCSE0653	Descriptive Analytics for IoT	3	0	0	0	3	3	
4.	BCSE0654	Ipv6 Analysis and Applications	3	0	0	0	3	3	
5.	BCSE0655	Big Data Analytics	2	0	0	0	2	2	
6.	BCSE0656	IoT for Industries	2	0	0	0	2	2	
7.	BCSE0657	Designer of Smarter Cities	2	0	0	0	2	2	
PRACTICALS									
1.	BCSE0681	Wireless Sensor Networks &IoT Standards Lab	0	0	2	0	1	2	
2.	BCSE0682	Cloud Architecture and Deployment Models Lab	0	0	2	0	1	2	
3.	BCSE0683	Descriptive Analytics for IoT Lab	0	0	2	0	1	2	
4.	BCSE0684	Big Data Analytics Lab	0	0	2	0	1	2	
Total			**18**	**0**	**8**	**0**	**22**	**26**	

BCSE0651: WIRELESS SENSOR NETWORKS (WST) & IOT STANDARDS

Objective:

Credits: **Semester III** **L–T–P-J: 3 – 3 –0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to Networks, Introduction to WSN, applications, topologies, Components of WSN – Transducer, Microcontroller, Battery, Transceiver, Geo-locator, Characteristics of WSN, WSN architecture, challenges of Deployment. **Energy:** Energy consumption, Energy efficiency, Energy scavenging. **OSI Network Model:** Introduction to different layers of OSI model. **WSN Simulation:** What is Simulation, types, Introduction to Simulator – QualNet,	20
II	**Routing:** Flooding based – Gossip, SPIN, Directed Diffusion, Hierarchical Based – LEACH, PEGASIS, TEEN, APTEEN, Location based Routing Protocols – MECN, SMECN, PRADA, QoS based – Speed, Minimum cost path routing. **Protocols:** Introduction to CoAP, MQTT, 6LoWPAN, Bluetooth, ZigBee, Z-WAVE, IPv6. **Operating Systems:** Introduction to WSN operating Systems – Tiny OS, Contiki, MANTIS. **Coverage and Localization –**Meaning of coverage and Localization**,** Full coverage, Perimeter Coverage. **IoT Open Source Tools:** Introduction to various IoT Open Source Tools.	20

Text Book:

- Wireless Sensor Networks (WST) and IoT Standards (IBM ICE Publication).

Reference Books:

- Fei Hu and Xiaojun Cao, "Wireless Sensor Networks Principles and Practice", CRC Press.
- Holger Karl and Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John Willey Publication.
- Feng zhao and Leonidas guibas, "Wireless Sensor Networks: an Information Processing Approach", Elsevier Publication.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Understand the basics of WSN.
- CO2: Explain Energy Management mechanism in WSN.
- CO3: Develop the project using QualNet.
- CO4: Explain the routing protocols in WSN.
- CO5: Understand the WSN operating systems and IoT Open Source Tools.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO12/PSO4

CO2	PO3/PSO1
CO3	PO5/PSO3
CO4	PO5,PO7/PSO2
CO5	PO4,PO5/PSO3

BCSE 0681: WIRELESS SENSOR NETWORKS (WST) & IOT LAB

OBJECTIVE: The objective is to enable students to work with different sensors and encourage them to think of different applications of WSNs.

Credits: **Semester III** **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I&II	• LED Blinking Experiment. • Using DHT sensor to measure Temperature and Humidity. • Using water level sensor to measure the level of water. • Experiment to turn on Buzzer automatically when temperature crosses a threshold value. • Experiment to turn on Buzzer automatically when water level crosses a threshold value. • Using Blynk to create a mobile application to turn on LED autiomatically. • Create different mobile applications using Blynk. • Access temperature data over the internet through ThingSpeak. • Creating different plots of temperature data on ThingSpeak. • Use distance sensor and send the distance information to ThingSpeak.	22

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the functions of different Sensors.
- CO2: Demonstrate the controlling of different sensors through mobile phone using Blynk.
- CO3: Demonstrate the accessing the sensor data over the internet through ThingSpeak.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO5,PO7/PSO4
CO2	PO10/PSO2
CO3	PO10/PSO2

BCSE0652: CLOUD ARCHITECTURE & DEPLOYMENT MODELS

Objective: The course enables students to understand the virtualization technology, Applications along with cloud computing concepts and services and to study different cloud architecture & deployment models.

Credits: 03 **Semester - IV** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Virtualization** Overview of Virtualization: Need of Virtualization, shortcoming of physical infrastructure, benefit of Virtualization, comparison of traditional IT infrastructure with virtualized infrastructure. **Virtualization** Implementing Virtualization, typical hardware / software server stack and its logical equivalence, pre/post virtualization server stack ,types of virtualization, area and technology based classification, history of virtualization, time sharing system, Extending Virtualization to x86 and its hardware support, impact of Virtualization: cost and manageability impact. **Server and Storage Virtualization** Types of Server Virtualization, simulation, Hardware Assisted Virtualization, Hypervisors, types of Hypervisors, Desktop Virtualization: Benefits Constraints and Types, storage Virtualization overview: benefit and types, features of logical layers, Host level storage Virtualization, host based mirroring, storage level Virtualization, network based storage Virtualization, Network and Application Virtualization. **Introduction to Cloud Computing** Overview: Introduction to cloud computing, Virtualization and cloud and its overlapping, types of services, business value, business impact of cloud, technological value of cloud, end user benefits, pros and cons of cloud model, anatomy of cloud, benefit of cloud, delivery and deployment model, different cloud architecture: public, private, hybrid and community its pros and cons, Service Models (XaaS), delivery models. Clint-server, cluster, grid models, cloud vs grid and their relationship, cluster and cloud, utility computing and evolution of cloud computing.	20
II	**Cloud computing Architecture:** Conceptual reference model, Cloud Computing solution components. Service Deployment, Cloud service management, IBM CC RA, SLA, Security and privacy **OpenStack:** Definition, Advantages, Releases, Architectural overview, Different components of Open Stack, Open stack- Hypervisors, Network Services, Storage - Block Storage, Object Storage, Choosing Storage Backends, Commodity Storage Backend Technologies: swift, Ceph, Gluster, Multiserver Openstack, Tenant model architecture, **Eucalyptus:** Introduction, Features and Functionality, Architecture, Basic and Advanced Components. Eucalyptus vs Openstack **OpenNebula:** Introduction, Features and Functionality, Architecture, Basic and Advanced Components. OpenNebula vs Openstack	20

Text Books:

- Introduction to Virtualization and Cloud Computing(IBM ICE Publication)
- Cloud Computing Architecture & Deployment Models (IBM ICE Publication)
- Raj Kumar Buyya, James Broberg, Andrezei M.Goscinski , Cloud Computing: Principles and paradigms, 2011.
- Bumgardner, V. C. , OpenStack in action. Manning Publications Company, 2016.

Focus: This Course focuses on Employability under CO1,CO2,CO3,CO5.

Outcome: After completion of course, student will be able to:

- CO1: Explain the core concepts of the cloud-computing paradigm.
- CO2: Describe the importance of virtualization along with their technologies like system, network, and storage virtualizations.
- CO3: Explain SaaS, PaaS, IaaS, XaaS, Public Cloud, Private Cloud and Hybrid Cloud.
- CO4: Describe the risk and security issues involved with the cloud computing Environment.
- CO5: Analyze the components of OpenStack
- CO6: Understand the Architecture and Components of Cloud Deployment and management tools like Eucalyptus, OpenNebula.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1,PO3,PO5,PO7/PSO2
CO3	PO1,PO5/PSO1
CO4	PO1,PO3,PO5/PSO2
CO5	PO1,PO2/PSO1
CO6	PO1,PO2,PO5/PSO1

BCSE0682: CLOUD ARCHITECTURE AND DEPLOYMENT MODELS LAB

Objective: This course covers aims to explain various technologies related to Cloud Computing deployment models and their practical implementations, discuss different architectural models of cloud computing, the concepts of virtualization and cloud orchestration.

Credits: 01 **Semester IV** **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I&II	1. a) Introduction to Packet Tracer. b) Network Topologies. (Including explanation of Simple PDU & Complex PDU.) 2. Connecting 3 netwoks using routers. Also, configure DHCP and DNS server. 3. Configuration of different Application services (SMTP, FTP, HTTP, TFTP, DHCP & DNS) 4. Configuration of Vlan and Inter- Vlan Routing. 5. Configure GRE over IP tunnel (VPN). 6. Static NAT configuration. 7. Configure Wireless network. 8. Configure different IoT devices. 9. Study on VMware a. Creating a VM b. Networking on VM c. Merging and splitting disk on VM d. Cloning the guest OS e. Deploying VM with template f. Creating Snapshots g. Managing Users, Groups, Permissions and Roles 10. Creating an EC2 instance on AWS 11. Configuration of db in AWS. 12. Creation of S3 bucket with single IAM user in AWS. 13. Deploying VM on Open Stack platform	18

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Implement the networking topologies and routing algorithms on Cisco Packet Tracer.
- CO2: Design Virtual Machines over Type- 1 & Type-2 Hypervisor & Test Client Server application over VMs created.
- CO3: Create the use cases of the key components of Amazon web Service.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5/PSO1
CO2	PO1,PO3,PO5/PSO2
CO3	PO1,PO3,PO5,PO7/PSO2

BCSE0653: DESCRIPTIVE ANALYTICS FOR IOT

Objective: *The purpose of the course is to provide an introduction to descriptive analytics in IoT. The concepts of business intelligence and its framework for IoT is discussed. The course provides an introduction to the concepts of big data and cloud in IoT. The various tools for IoT analytics is introduced with supporting case studies.*

Credits: 03 **Semester V** **L–T–P-J:3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Analytics for IoT:** Definition, Internet of things and analytics, Types of analytics, Decision support systems: Business intelligence, Sample BI architecture, functional areas of BI tools, Collaborative BI **Descriptive analytics:** Introduction to descriptive analytics for IoT Benefits of BI, maximize value from BI systems, Strategy and business intelligence, five key areas of strategy, Planning a BI project. **BI framework for IoT:** BI architecture, Centralized versus decentralized architecture, System sizing, measurement and dependencies, authentication, authorization and access permissions, Server administration. BI framework for IoT. **Ecosystem preparation**: Device, network and software layer integrations, The functional architecture of IoT, Data mart framework, Data layer framework, Presentation layer framework.	20
II	**Data warehouse:** Characteristics, Multidimensional data, Classic star schema, Three-tier data warehouse architecture, Multi-tiered architecture Data analysis and OLAP **IoT data for analytics:** Data life cycle management, Sensor data: Problem of plenty data governance, Data collection: Capture of data, Data transportation: ETL strategy for IoT data, Data storage, Data processing: Analytics **Data consumption:** Visualization, Building data marts for IoT data OLAP: Server architectures, Typical OLAP operations, Dashboards and scorecards development, Dashboard types Layers of information Categorizing dashboards, Dashboard design principles, Dashboard design rules, building reports, Data group and sort, drilling in report: Drill up and down, Visualization of IoT data analytics **Big data analytics for IoT**: Introduction, need for big data, Characteristics of big data, Structure of big data and need for standards, Big data analytics adoption, Benefits & barrier of big data analytics, Trends for big data analytics, Commoditization of hardware enabling new analytics, Wide ranging analytics and techniques Big data platform and application frameworks, A big data platform manifesto Big data and IoT, BI from big data for IoT, context analytics, Real-time analytics. **Overview of cloud in big data:** Integration of devices on cloud for analytics, cloud and Big Data	20

Text Book:

- IBM Training Front Cover Student Notebook Analytics for IoT

Reference Books:

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Understand the basics of analytics and types of analytics.
- CO2: Explain the BI architecture and BI components.
- CO3: Explain the different layer frameworks.
- CO4: Understand the basics of different tier data warehousing.
- CO5:Explain the OLAP operations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3
CO2	PO1,PO3/PSO2
CO3	PO1,PO3/PSO2
CO4	PO1,PO5/PSo2,PSO3
CO5	PO1,PO3/PSO3

BCSE0683: DESCRIPTIVE ANALYTICS FOR IOT LAB

Objective: *This course covers aims to explain various technologies related to Data Analytics with IoT for BI solutions, practical implementations of automated data scraping, screen recording etc, and discuss azure for virtualization and cloud orchestration.*

Credits: 01 **Semester V** **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I&II	• Installation of UIPath • Process creation, Management of activity packages and configuration • Use of variables and Arguments • Use of sequence, flowcharts, and workflow • Perform input by using input methods • Perform reverse of string • Perform Automatic Recording with Desktop • Perform data scraping from Wikipedia • Perform Screen Scraping • Perform Image automation and OCR • Login to azure and subscribe student account • Raspberry configuration with azure IOT • Azure IOT Data Analysis with Power BI	20

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of course, student will be able to:

- CO1: Implement the different automated Desktop Recording project.
- CO2: Design the Data Scraping from web.
- CO3: Understand Azure IOT Data Analysis with Power BI.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO2
CO2	PO1,PO3/PSO2,PSO4
CO3	PO1,PO5/PSO2,PSO4

BCSE0654: IPv6 ANALYSIS AND APPLICATION

Objective: The course aims at creating knowledge on the networking concept especially in next generation IP along with its challenges, applications, routing and security. Student will also be achieving the learning in simulation of next generation IP.

Credits: 03 **Semester - IV** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to IP:** Introduction to IP, IPv4, Limitations of IPv4, Exhaustion of IPv4 Addresses, Introduction to NAT. **IPv6:** Next generation IP (IPv6), Introduction and motivations behind IPv6 deployment, Workarounds In IPv6, current status and projections. **Dual stack, Tunneling, Challenges in deployment of IPv6, Structure of the IPv6 packet: base header,** Hop-by-Hop extension header, source routing and fragmentation. Comparing Ipv4 and IPv6 Header, IPv6 address architecture. Address categories and scopes. Current IPv6 prefix allocation, global, link-local, local unicast, loopback addresses. Mapping IPv4 addresses to IPv6 addresses, **Addresses in IPv6:** Multicast addresses, Anycast addresses, IPv6 Interface ID determination: privacy issues. Any cast addresses: use cases and possible implementations. Multicast addresses: scope definition and use cases. **Introduction to Changed Protocol and Routing:** RIPng, OSPFv3, BGPv4, DHCPv6, DNS, Stateless and Stateful auto-configuration, Introduction to QOS (Traffic class and Flow label). **Introduction to Packet tracer and Ipv4 and Ipv6 Simulation:** Overview & Simulation scenario.	20
II	**6LOWPAN and ICMPv6:** New functionalities; Neighbour Discovery protocol and address auto configuration. Interoperability with IPv4: dual-stack and tunnelling techniques. Introduction to 6LoWPAN and its architecture: simple, extended and ad-hoc networks. Issues in determining IPv6 links in LLNs and illustration of the undetermined link addressing model. IPv6 addressing in 6LoWPAN.6LoWPAN forwarding: route-over and mesh under approaches. Illustration of the 6LoWPAN adaptation layer header format. IP header compression: stateless vs. stateful options. IP header compression in 6LoWPAN. 6LoWPAN,ICMPv6. **Introduction to RPL:**	20

	The IPv6 Routing Protocol for LLNs, RPL: multi-point to point routing with destination oriented directed acyclic graphs. RPL instances, routing metrics and constraints, objective functions. RPL: loop detection and avoidance, P2MP and P2P routing CoAP proxying. Example of a CoAP-to-CoAP proxy. Resource observing and Service discovery. **Security Requirements on IPv6**	

Text Books:

- Introduction to Ipv6 Analysis and Applications (IBM ICE Publication).
- Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, John Wiley & Sons.

Reference Books:

- Hagen, S. . IPv6 essentials. Farnham: OReilly, 2002.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome:

- CO1: Understand the difference between IPv4 and IPv6.
- CO2: Demonstrate the mapping between IPv4 and IPv6.
- CO3: Explain the concepts of ICMPv6, 6LoWPAN and IPv6.
- CO4: Explain the basics of RPL.
- CO5: Demonstrate the simulations of IPv6 under Cisco Packet Tracer and Cooja simulator environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO10/PSO2
CO2	PO10/PSO1
CO3	PO1,PO10/PSO2
CO4	PO1,PO10/PSO1
CO5	PO5/PSO2

BCSC0655: BIG DATA ANALYTICS

Objective*: To cover the concept of big data and its analytics, Hadoop map reduce, mongo database and cassandra file system*

Credits: 04 **Semester II** **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Big Data:** Data-Definition, Representation, Types of Digital Data: Structural, Semi-Structural & Unstructured, Need of Big Data Big Data – Definition, Characteristics of Big Data, Units to measure Big data, Big data types, Benefits & Barrier of Big Data Analytics, Big data Sources, Scalability and Scaling up techniques. - Concept of Horizontal and Vertical scalability. **Big data computing environment**: Hadoop Fundamentals: What is Hadoop? Introduction to Hadoop, Data Distribution, HDFS-Hadoop Distributed File System, Name Nodes, Data nodes, DataNodes with Blocks of Multiple Files with a Replica. Yarn, Hadoop 1.0, Hadoop 2.0 and Hadoop3.0 **MapReduce:** an example of MapReduce, The Map function, Sort phase, Reduce function, Combiner and Partition functions, MapReduce example: wordcount. NoSQL technology, CAP Theorem, ACID Properties. **HADOOP Ecosystem and Flume**: Introduction to Hadoop Ecosystem, Introdcution to Sqoop, Zookeeper.	21
II	**Introduction to Mongo DB**: RDBMS vs. MongoDB, JSON, Unique Key, Dynamic Queries, Sharding, Replication, MongoDB QL: Create, Drop Database and Collections, CRUD: Create, Insert, Find, Update, Delete, Map Reduce Programming, Aggregations **Introduction to Cassandra DB**: Features of Cassandra, CQL Data Types, CQLSH: CRUD, Counter, TTL, List, Set, Map, Tracing, Import Export csv files **Introduction to HBase**: What is HBase? HBase Architecture, HBase Components, Data model, HBase Storage Hierarchy, Cross-Datacenter Replication, Auto Sharding and Distribution, Bloom Filter and Fold, Store, and Shift **Introduction to HIVE**: Hive Architecture, Hive Data types, Hive Collection Types, Hive File Formats, Hive Query Language, Hive Partitions, Bucketing, Views. **Introduction to Pig**: History and Anatomy of Pig, Pig on Hadoop, Use Case for Pig, Pig Primitive Data Types, Pig Latin Overview, Execution Modes of Pig, Field, Tuple, Bag, User Defined Function, Parameters in Pig, Piggy Bank, Word count example using Pig, Pig vs Hive.	20

References:

- Seema Acharya, Subhashini Chellappan , “Big Data and Analytics”, First Edition, WILEY, 2015.
- Chuck Lam , “Hadoop in Action”, Second Edition, Manning, 2018.

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome:

- PO1: Understand Architecture for Big Data.
- PO2: Understand concept of Hadoop and its various versions.
- PO3: Understands YARN, HDFS and Map Reduce Algorithm.
- PO4: Understand Hadoop Eco system.
- PO5: Understand data access through HIVE, PIG etc.
- PO6: Understand MongoDB database and Cassandra file system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PSO2
CO2	PO2, PO4/PSO1
CO3	PO1,PO3/PSO3
CO4	PO3,PO5/PSO4
CO5	PO2,PO3,PO4/PSO1
CO6	PSO2/PSO3

BCSE0656: IoT FOR INDUSTRIES

Objective: *This course introduce how IoT has become a game changer in the new economy where the Customers are looking for integrated values.*

Credits: 02 **Semester VI** **L–T–P-J: 2–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to IoT, What is IIoT? IoT Vs. IIoT, History of IIoT, Basics of industrial IoT, Industrial Sensing and actuation, Cyber Physical System and Next generation Sensors. **IoT Physical Device: Raspberry Pi-** Understanding Pi hardware, Installation of software tools, Connecting with Pi hardware and Running existing programs **M2M protocol:** Open Mobile Alliance Lightweight Machine to Machine Protocol(OMALWM2M)	14
II	**Smart Automotive, Logistics and Supply Chain Via IoT:** Introduction to Automotive Domain, Infotainment Systems- In-Vehicle Infotainment system (IVI), Wire Replacement, Predictive Maintenance, Connected Vehicle Infrastructure-V2V, The Retail Domain, Intelligent Shopping, Energy Management- Smart Building Management, Controlling the Retail Supply Chain, Controlling payments using IoT, Analytics for increasing Store Insights, IoT in Logistics, Tracking Quality of the Shipment, Storage incompatibility detection, Fleet Tracking, **Industrial IoT- Application Domains:** Healthcare, Power Plants, Oil, chemical and pharmaceutical industry, Agriculture and Sports **Real case studies:** Smart City implementation using IoT	14

Text Books:

Reference Books:

- IoT for Industries, Edition 1.0, May 2020, IBM Corporation.
- Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Focus: This Course focuses on Employability under CO1,CO2,CO3.

Outcome: After completion of the course, the student will be able to:

- CO1: Describe IoT and IIoT
- CO2: Understand the main characteristics of next generation industrial sensors.
- CO3: Understand, design and develop the real life IIoT applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2/PSO3
CO3	PO4,PO5/PSO4

BCSO0001: DATA STRUCTURES AND APPLICATIONS
(Open Elective)

Objective: *The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs*.

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Terminology, Elementary Data Organization, Properties of an Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic Notations - Big Oh. **Linked Lists:** Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Generalized Linked List, Polynomial Representation and Addition. **Stacks:**Primitive Stack Operations - Push & Pop, Array and Linked Implementation of Stack in C, Application of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of infix to postfix expression, Recursion, Principles of Recursion, Tail Recursion, Removal of Recursion, use of stack in Recursion. **Queues:** Operations on Queue - Add, Delete operations, Implementation of Queue Using Array and Linked List, Circular Queues, Dequeue and Priority Queue.	20
II	**Trees:** Basic Terminology, Array Representation and Dynamic Representation; Complete Binary Tree,Extended Binary Trees, Tree Traversal Algorithms - Inorder, Preorder and Postorder. **Search Trees:** Binary Search Trees (BST), Insertion and Deletion in BST, Introduction to B tree. **Graphs:** Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees - Prims and Kruskal Algorithm; Shortest Path Algorithm - Dijkstra Algorithm. **Searching:** Sequential Search, Binary Search. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Two Way Merge Sort, and Heap Sort. **Hashing:** Hash Function, Collision Resolution Strategies.	20

Text Book:

- Horowitz and Sahani (2004-05), "*Fundamentals of Data Structures*", 3rd Edition, W H Freeman & Co.

Reference Books:

- Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein (2009), "Data Structures Using C and C++", 2nd Edition, PHI.
- Jean Paul Trembley and Paul G. Sorenson (2007), "An Introduction to Data Structures with Applications", 2nd Edition, TMH.
- R. Kruse, "Data Structures and Program Design in C" (2004), 2nd Edition, Pearson Education.
- Lipschutz Schaum's Outline Series (2010), "Data Structures", 12th Reprint, TMH.
- G A V Pai (2009), "*Data Structures and Algorithms",* TMH.

Focus: This Course focuses on Employability under CO1, CO2, CO6, CO7.

Outcome: After completion of course, student will be able to:
- CO1: Understand the basic concepts of the data structure and algorithms.
- CO2: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- CO3: Apply the associated operations in linear data structure like stack, Queue and link list.
- CO4: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.

- CO5: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- CO6: Select the appropriate data structure to solve the problem.
- CO7: Apply the shortest path algorithm to solve real life problem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2
CO3	PO1/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4/PSO3
CO6	PO2/PSO4
CO7	PO2/PSO4

BCSO0070: DATA STRUCTURES AND APPLICATIONS LAB
(Open Elective)

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	• Program to implement various operations in a singly linked list. • Program to implement insertion, deletion and traversal in a doubly linked List. • Program to implement polynomial addition using linked list. • Program to demonstrate the various operations on stack. • Program to convert an infix expression into postfix expression. • Program to evaluate a given postfix expression. • Program to demonstrate the implementation of various operations on linear and circular queue. • Program to demonstrate the implementation of insertion and traversals on a binary search tree. • Program to search a given element as entered by the user using sequential and binary search to search a given element as entered by the user. • Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.	24

Note: All Code must be done in Java as well as Python

Focus: This Course focuses on Employability under CO1, CO2, CO3.

Outcome: After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

BCSO0002: INTRODUCTION TO OBJECT ORIENTED PROGRAMMING
(Open Elective)

Objective: *The objective of the course is to understand the fundamentals the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**OO Fundamentals:** Need of OO approach, OO Concepts. Characteristics of Object oriented programming. **Basics of Java:** Features of Java, Byte Code and Java Virtual Machine, JDK, Data types, Operator, Control Statements. **Array and String:** Single and Multidimensional Array, String class, Operations on string, Command line argument, Use of Wrapper Class. **Classes, Objects and Methods:** Class, Object, Constructor, new operator, Constructor Overloading, Method Overloading, Recursion, Passing and Returning object form Method, this and static keyword(variable, method, class and package), Access control, modifiers, Nested class, Inner class, Abstract class, Java Standard Libraries. **Polymorphism:** Method overloading. **Inheritance and Interfaces:** Use of Inheritance, Inheriting Data members and Methods, constructor in inheritance, Types of Inheritance, super keyword, Final keyword, Creation and Implementation of an interface, Dynamic method dispatch, Comparison between Abstract Class and interface.	20
II	**Multithreaded Programming:** Use of Multithread programming, Thread State Diagram, Thread class methods, Runnable interface, Thread priority. **Exception Handling:** Exception and Error, Built in Exception, Use of try, catch, throw, throws and finally, Custom exception. **GUI Programming:** Java Applet, Applet life cycle, Applet Vs Application, Graphics methods, Layout- Flow, Grid, Border, Introduction to AWT Programming, Introduction to Swing, AWT Vs Swing, GUI development in AWT, Swings, Event Delegation Model, Event Handling using Button. **JDBC:** Database Connectivity Model, Types and Roles of Drivers, Database Connectivity Statements, Communicating with Database.	20

Text Books:
- Herbert Schildt, "Java the Complete Reference", TMH. 8th edition.

References:
- Kathy Sierra & Bert Bates, "Head First Java", O'Reilly, 2nd Edition.
- Patrick Naughton, "Java Handbook", Osborne McGraw-Hill.
- Khalid A Mughal, Rolf W Rasmussen, "A Programmer's Guide to Java SE 8 Oracle Certified Associate (OCA)",Addison-Wesley Professional.

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4, CO5, CO6.

Outcome: *After completion of course, student will be able to:*
- CO1: Understand differences between procedures oriented and object-oriented approach in problem solving
- CO2: Analyze, write, debug, and execute basic Java codes
- CO3: Apply the concepts of object oriented programming (class, constructor, instance, data abstraction,
- inheritance, and polymorphism) in developing the programs

- CO4: Analyze or Inspect a piece of code with run time errors (exceptions) and debug it with proper exception handling
- CO5: Apply multithreaded programming to work with the multithreaded architecture of a CPU using Java.
- CO6: Understand how to develop a GUI application and apply JDBC for communicating with database.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3/PSO1,PSO2
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1,PSO2
CO4	PO1/PSO2,PSO4
CO5	PO1,PO2,PO4/PSO4
CO6	PO1,PO2, PO3/PSO2

BCSO0071: INTRODUCTION TO OBJECT ORIENTED PROGRAMMING LAB

(Open Elective)

Objective: *The objective of this course is that students will study and learn Object Oriented Modeling and programming.*

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	**1.** The Fibonacci sequence is defined by the following rule. The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a java program that uses both recursive and non recursive functions. **2.** Write a java program for sorting a given list of names in ascending order. **3.** Design a class to represent a bank account. Which include contains account number, name of the depositor, type of the account, balance amount in the account. Use constructors to assign initial values, to Deposit an amount, to Withdraw amount after checking balance, to display name and balance. .(Hint: constructor overloading). **4.** Write a java program to create an abstract class named Shape that contains two integers and an empty method named print Area (). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape. **5.** Write a java program to create an interface named Shape that contains empty method named Area() and Perimeter(). Provide two classes named Triangle and Circle such that each one of the classes implements Shape. Each one of the classes contains only the method Area () and Perimeter().that prints the area and perimeter() of the given shape. **6.** You will be given two integers x and y as input, you have to compute x/y. Implement a class which raise an exception if x and y are not signed integers or if y is zero. **7.** Write a java program to implement user defined exceptions. **8.** Write a java program that implements thread class methods. **9.** Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number. **10.** Write a java program that connects to a database using JDBC and does add, delete, modify and retrieve operations. **11.** Write a java program that simulates a traffic light. The program lets the user select one of three lights: Red, Yellow or Green with radio buttons. On selecting a button an appropriate message with "STOP" or "READY" or "GO" should appear above the buttons in selected color. Initially, there is no message shown. **12.** Develop an applet that displays a simple message.	**24**

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Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4.

Outcome: *After completion of lab, student will be able to:*

- CO1: Analyze, write, debug, and execute basic Java codes
- CO2: Understand the practical difference between object oriented programming and procedural oriented language and data types in Java.
- CO3: Implement all the concepts of object oriented such as objects, classes, inheritance, polymorphism etc.
- CO4: Understand to develop a GUI application and apply JDBC for communicating with database

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO4
CO3	PO5/PSO2
CO4	PO2,PO3/PSO2

BCSO0003: ESSENTIALS OF INFORMATION TECHNOLOGY
(Open Elective)

Objective: *The course introduces you to the basic concepts of the World Wide Web, and the principles and tools that are used to develop Web applications. The course will provide an overview of Internet technology, PHP and Database that provides understanding of how server-side programming works on the web.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Internet:** Concept of WWW, Internet Architecture, Client-Server model, HTTP Protocol: Request and Response, Web Browser and Web Servers. **HTML:** Basics of HTML, Formatting and Font tags in HTML, Tags-commenting code, color, hyperlink, lists, tables, images, forms, meta, frames and frame sets, Character entities. **Style sheets:** Need for CSS, Introduction to CSS, Basic Syntax, Ways to embed CSS in HTML page, **JavaScript:** JavaScript usages, Client side scripting with JavaScript, Variables, Functions, Conditions, Loops and Repetition, Pop up boxes, Forms and Validations, Ways to embed JavaScript in HTML. **Client-Server Implementation:** Introduction to PHP, Embedding PHP in HTML, Variables, Constants and String Manipulation functions. **Form Handling and Session Management in PHP:** Accessing and displaying Form data from different Form components, Session management, PHP and MySQL.	20
II	**Introductory concepts of DBMS:** Introduction and applications of DBMS, Purpose of Database, Data, Independence, Database System architecture- levels, Mappings, Database, Users and DBA. **Relational Model:** Structure of Relational Databases, Domains, Relations. **Entity-Relationship model:** Basic concepts, Design process, Constraints, Keys, E-R diagrams. **Relational Database design:** Functional Dependency – Definition, Trivial and Non-Trivial FD, Normalization – 1NF, 2NF, 3NF and BCNF. **Transaction Management:** Transaction concepts, Properties of transactions. **Basics of Software Development Life Cycle:** Introduction to Software and Software Engineering, SDLC Models and Approaches- Waterfall Model, Software Requirement Specification Document, Requirement Verification and Validation, Software Testing, Types of Testing.	20

References:

- Steven Holzner,"HTML Black Book", Dremtech press.
- Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel Pearson.
- Elmasri and Navathe (2010), *"Fudamentals of Database Systems"*, 6th Edition, Addision Wesley.
- Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw Hill.
- Learning PHP, MySQL, books by ' O'reilly Press.
- R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
- Rajib Mall, Fundamentals of Software Engineering, PHI Publication.

Focus: This Course focuses on Employability under CO1, CO4, CO5, CO6.

Outcome: *After completion of course, student will be able to:*
- CO1: Understand the principles of creating an effective web page, including an in-depth consideration of information architecture.
- CO2: Become familiar with graphic design principles that relate to web design and learn how to implement theories into practice.
- CO3: Learn the language of the web: HTML, CSS and Javascript.

- CO4: Apply their foundations in software engineering to adapt to readily changing environments using the appropriate theory, principles and processes.
- CO5: Be able to write SQL commands to create tables and indexes, insert/update/delete data, and query data in a relational DBMS.
- CO6: Have a broad understanding of database concepts and database management system software.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	PSOs / POs
CO1	PSO2, PSO4 / PO1, PO3, PO6
CO2	PSO2, PSO3 / PO2 PO11, PO12
CO3	PSO1, PSO2 / PO5, PO7, PO8, PO12
CO4	PSO1, PSO4 / PO2, PO6, PO9, PO10
CO5	PSO1, PSO2, PSO4 / PO4,PO5, PO8
CO6	PSO2, PSO3 / PO1, PO2, PO4

BCSO0072: INFORMATION TECHNOLOGY LAB
(Open Elective)

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	• Design web pages for your college containing a description of the courses, departments, faculties, library etc, use href, list tags. • Create user Student feedback form (use textbox, text area, checkbox, radio button, select box etc.) • Create a web page using frame. Divide the page into two parts with Navigation links on left hand side of page (width=20%) and content page on right hand side of page (width = 80%). On clicking the navigation Links corresponding content must be shown on the right hand side. • Design a web page of your home town with an attractive background color, text color, an Image, font etc. (use internal/external/inline CSS). • Create HTML Page that contains form with fields Name, Email, Mobile No, Gender, Favorite Color and a button now write a JavaScript code to combine and display the information in textbox when the button is clicked. • Implement Validation in above Feedback Form. • Data Definition Language (DDL) commands in RDBMS. • Data Manipulation Language (DML) and Data Control Language (DCL) commands. • Aggregate function in SQL and SQL nested query. • Write a PHP program to display today's date in dd-mm-yyyy format. • Write a PHP program to check if number is prime or not. • Write a PHP program to print first 10 Fibonacci Numbers. • Create HTML page that contain textbox, submit / reset button. Write PHP program to display this information and also store into text file. • Write a PHP Script for login authentication. Design an html form which takes username and password from user and validate against stored username and password in file. • Write PHP Script for storing and retrieving user information from MySql table: Design a HTML page which takes Name, Address, Email and Mobile No. From user (register.php). Store this data in Mysql database / text file. Next page display all user in html table using PHP (display.php)	24

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: *After completion of lab, student will be able to:*

- CO1: Understand, analyze and apply the role languages like HTML, CSS, JavaScript and protocols in the workings of web and web applications.
- CO2: Understand, analyze and apply common SQL statements including DDL, DML and DCL statements to perform different operations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO5, PO7, PO8, PO12/ PSO1, PSO2

CO2	PO1, PO2, PO5, PO7, PO8, PO12/ PSO1, PSO2

BCSO0004: ELEMENTS TO SOFT COMPUTING
(Open Elective)

Objective: *Students will get an insight of the intelligent computational approaches. Providing students, the mathematical background to carry out optimization.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I.	Introduction to Soft Computing **Artificial Intelligence:** Introduction to AI, Applications of AI, Heuristic Search: Problem Solving, Techniques for heuristic search, heuristic classification, **Genetic Algorithm (GA):**Introduction to GA, Representation, initialization and selection, operators of GA. Introduction to Evolutionary programming. **Fuzzy Logic:** Introduction to Fuzzy Logic, Fuzzy Sets & Crisp Sets, Fuzzy Membership and Fuzzy Operations, Properties of Fuzzy Sets, Crisp Relations and Fuzzy Relations, Fuzzy System, Crisp Logic,	20
II.	**Fuzzy Logic:** Fuzzy Logic, Inference in Fuzzy Logic, Fuzzy Rule Based System, Fuzzification&Defuzzification, Applications of Fuzzy Logic. **Neural Networks:**Fundamentals of Artificial NeuralNetwork (ANN), Models of ANN, Architectures of ANN (Feed Forward and Feedback N/W), Learning Methods in ANN, Mc Culloch Pitts Neuron, Single Layer Perceptron, Perceptron Learning Rule, Error Back Propagation Network (EBPN), Associative Memory, Applications of Neural Network.	21

Text Book:

- S. Rajsekaran & G.A. Vijayalakshmi Pai(2003), *“Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”*, 4th Edition, Prentice Hall of India.

Reference Books:

- Timothy J Ross (2009), *"Fuzzy Logic with Engineering Applications"*, 3rd Edition, John Wiley and Sons.
- David E. Goldberg (2009), *"Genetic Algorithm in Search Optimization and Machine Learning "*, Adission-Wesley.
- Simon Haykin (2008), “*Neural Networks and Learning Machines*”, Prentice Hall; 3rd edition
- Karray (2009), *“Soft Computing and Intelligent Systems Design: Theory, Tools and Applications”*, 1st Edition, Pearson Education.

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4, CO5.

Outcome: *After completion of lab, student will be able to:*

- CO1: Understand basics of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
- CO2: Identify an evolutionary computing paradigm known as genetic algorithms and its applications to engineering optimization problems.
- CO3: Understand about the fundamental theory and concepts of neural networks, neuro modeling, several neural networks paradigms and its applications.
- CO4: Design and implement the concepts of knowledge using fuzzy inference systems and other machine intelligence applications.

- CO5: Demonstrate the ability to develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1, PO2, PO3/PSO3
CO2	PO2, PO3, PO4/PSO2
CO3	PO2, PO3, PO5/PSO4
CO4	PO1, PO12/PSO4
CO5	PO2, PO5, PO12/PSO4

BCSO0073: ELEMENTS TO SOFT COMPUTING LAB
(Open Elective)

Objective: To provide hands-on experience in selected applications.

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	• Overview of Matlab • Write a program for all types of crossover methods. • Write a program for complete Genetic Algorithm cycle. • Program for fuzzy set with properties and operations • program for composition on Fuzzy and Crisp relations • Program to find a relation using Max-Min Composition, enter the two vectors whose relation is to be find • Method of Defuzzification • WAP for design an inference system using membership function • Plot different types of activation functions. • Program to create a perceptron network using command 'newp' • Program for single perceptron • To implement AND function using ADALINE with bipolar inputs and outputs. • To construct and test auto associative network for input vector using HEBB rule • Create a multilayer perceptron network and write a Program for Backpropagation network.	24

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4, CO5.

Outcome: After completion of Lab, student will be able to:

- CO1: Effectively use existing software tools to solve real problems using a soft computing approach
- CO2: Evaluate and compare solutions by various soft computing approaches for a given problem.
- CO3: Understand about the fundamental concepts of neural networks, neuro modeling, several neural networks paradigms and its applications.
- CO4: Design and implement the concepts of knowledge using fuzzy inference systems and other machine intelligence applications.
- CO5: Demonstrate the ability to develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1, PO2, PO3/PSO2
CO2	PO2, PO3, PO4/PSO3

CO3	PO2, PO3, PO5/PSO4
CO4	PO1, PO12/PSO4
CO5	PO2, PO5, PO12/PSO3

BCSO0005: FUNDAMENTALS OF COMPUTER
(Open Elective)

Objective: *This course on fundamental of computers and data handling would ensure that the students get first-hand exposure to the fundamentals of computers and get acquainted with handling of the same.*

Credits: 02 **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I.	**Computer fundamentals:** Definition of computer, characteristics of computer, generation of computers, classification of computers, block diagram of computers. **Software and hardware:** Application and system software, Hardware-I/O devices, CPU components, storage devices. **Understanding of Word processor:** Opening and closing of word document, text creation and manipulation, formatting of text, table handling, spell check, printing of word document. **Number System:** Bit, Byte, Binary, Decimal, Hexadecimal and Octal number systems and their inter-conversions. **Translator:** Assembler, compiler, interpreter, linker and loader	14
II.	**Introduction to Operating system:** definition, functions, CUI and GUI based operating systems. **Introduction to spreadsheet:** manipulation of cells, formulas and functions, printing of spreadsheet. **Introduction to Computer Network:** definition, advantages, network topologies, communication media. **Making Presentation:** creating presentation, preparation of slides, slide show, taking printouts of presentation. **Internet and its applications:** E-mail-sending and receiving emails, file attaching with email, WWW, web browsers, search engine, internet and applications. **Cybercrime:** Introduction and its types.	14

Text Book:

- P.K. Sinha, (2008), “Computer fundamentals”, BPB Publisher, New Delhi, 4th edition.

Reference Books:

- Anita Goel, “Computer fundamentals”, Pearson Education.
- Peter Nortron, “Inside PC”, TMH, New Delhi.
- Alexis Leon, Methews Leon, (1999), “Fundamentals of Information Technology”, Vikas Publishing, New Delhi.

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4.

Outcome: *After completion of course, student will be able to:*

- CO1: Understand the basic operational knowledge of computer and its components (Hardware, Software and storage devices) .Able to use M.S. Office (M.S. Word, M.S. Power point, M.S. Excel and M.S. Access) efficiently.
- CO2: Demonstrate the different type of number conversions, translator and operating system.
- CO3: Demonstrate the different types of networking, communication, internet and its application.
- CO4: Understand the cyber-crimes, cyber laws and cyber security parameters.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	PSOs/ POs
CO1	PSO2/PO1,PO5,PO10
CO2	PSO1,PSO3/PO1,PO5,PO12
CO3	PSO2,PSO3,PO1,PO3,PO5,PO10
CO4	PSO1,PSO4,PO6,PO7,PO8

BCSO0074: FUNDAMENTALS OF COMPUTER LAB
(Open Elective)

Objective: To provide hands-on experience in Microsoft Office tools.

Credits: 01 **L–T–P: 0–0–2**

<table>
<tr><th>Module No.</th><th>Content</th><th>Lab Hours</th></tr>
<tr><td>I</td><td>Word Processing (MS Word)
Introduction to MS Word: Menu Bar, Menus, Submenus, Tool Bar, Tools, Customizing Toolbar, Hiding Toolbar etc., Creating and Saving Documents, Working with an Existing Document, Auto Text, Auto Complete and Auto Correct.
Formatting a Document: Change the Appearance of Text & Paragraph, Copy, Paste and Paste Special Functions, Creating and Modifying a List, Page Break Options and Orientation, Changing the Look of Documents with Styles.
Using Tables and Columns: Table Creation and Modification Giving Stress to Auto-Fit, Auto-Format and Table Sort. Working with Data in Table Giving Stress to Formulas, Presenting Text in Columns, Object Linking and Embedding, Inserting and Sizing Graphics, Hyperlink Envelopes & Label Creation, Grammar & Spell Check, Previewing and Printing Documents.
MS Excel
Introduction to Electronic Spreadsheet and Microsoft Excel: Creating and Formatting a Worksheet, Features of Excel, Inserting and Formatting Data in a Worksheet, Working with an Existing Data List, Auto Fill, Fill Series and Auto - complete Options, Formatting Cells; Sorting & Filtering Data, Conditional Formatting, Formulas and Functions (Details Usage of Important Data Functions Like Sum, If, Average etc.); Interlinking Worksheets and Files, Setting Filters and Performing Calculations on Filtered Data etc
Presentation (Power Point Presentation)
Introduction to Power Point: Creating A Presentation: Features of Power Point - Editing Master Slides, Viewing and Editing a Presentation, Inserting, Sorting, Hiding and Deleting Slides, Inserting Pictures. Clip Art and Movies in a Slide: Creating and Enhancing a Table, Slide Layouts, Modifying the Slides and Title Master, Adding Transition and Animation Effect, Hyper Linking Slides & Files
Internet and its applications: E-mail-sending and receiving emails, file attaching with email.</td><td>24</td></tr>
</table>

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of Lab, student will be able to:

- CO1: Familiar with Microsoft Office tools such as MS Word, MS Excel and Power Point Presentation.
- CO2: Practical Exposure of internet and its applications(Email handling,Web browsing)

COs	Pos/ PSOs
CO1	PO1,PO5,PO10/ PSO2
CO2	PO1,PO3,PO5,PO10/ PSO2,PSO3

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

BCSO0006: INTRODUCTION TO PROGRAMMING
(Open Elective)

Objective: *Students will get an insight of the fundamentals of Computer Programming, Problem solving using Computers.*

Credits: 02 **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I.	**Algorithm and flowchart:** Introduction, Features, symbols, sequential, conditional and iterative algorithms and flowcharts. **Basics of C:** Overview, Structure of a C program, Identifier, Keywords, Variables, Data types, Formatted Input and output. **Operators and Expression:** Assignment, Unary, Arithmetic, Relational, Logical, Bitwise, Conditional, Special operators and their precedence & Associativity. **Type Conversion:** Type Promotion in expression, Conversion by Assignment, Truncation and Casting Arithmetic expression. **Decision and Case Control Structure:** if, if-else, nested if-else, Decisions using switch, switch versus if-else ladder, goto.	14
II.	**Loop Control Structure:** For loop, while loop, do-while loop, nesting of loops, break, and continue. **Arrays:** Introduction, one dimensional and two dimensional Array, Declaration, Initialization. **Operations on Arrays**: Insertion, Deletion, Linear Search & Bubble Sort. **String:** Introduction, One dimensional and two dimensional Array - Declaration, Initialization **Operations on String:** Length, Copy, Reverse, Concatenate, Compare with & without built-in functions. **Functions:** function types, array passing to a function. **Introduction to storage class:** auto, register, static and extern in single file.	14

Text Book:
- Yashavant P. Kanetkar, (2007), "Let us 'C'", BPB Publication, 8th edition.

Reference Books:
- Peter Vander Linden, Schaum's, "Outline of theory and problems of programming with C ," TMH.
- Balagurusamy E., "Computing Fundamentals and C Programming", TMH
- Vander Linden, "Expert C programming", PHI.

Focus: This Course focuses on Employability under CO1, CO2, CO3, CO4.

Outcome: After completion of course, the student will be able to:
- CO1: Implement the algorithms and draw flowcharts for solving problems and understanding the basics of C.
- CO2: Design and develop Computer programs and familiar with concept of control and loop structure.
- CO3: Understand the concept of array and its applicability in C programming
- CO4: Understand the concept of functions and storage classes

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2,PO3,PO5/ PSO1,PSO3
CO2	PO1,PO3,PO12/ PSO1,PSO4
CO3	PO2,PO4,PO6,PO8/ PSO1,PSO2,PSO3,PSO4
CO4	PO4,PO5,PO6,PO11/ PSO2,PSO4

BCSO0075: PROGRAMMING LAB
(Open Elective)

Objective: The objective is to provide a study of the C programming language.

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	Introduction to Linux environment Basic programs using input/ output functions Operators, their precedence and associativity • Arithmetic Operators on Integers • Arithmetic Operators on Floating point numbers • Relational Operators • Ternary Operators • Formatted Input and Output Decision Control • if statement, else statement, if else if ladder, Switch-Case Statement Programming based on loops • for loop, while loop, do while loop, Nested loops Use of special control statement • break, continue Programming based on Array • One dimensional Array, Two dimensional Array Programming based on string • Programming based on functions	24

Focus: This Course focuses on Employability under CO1, CO2.

Outcome: After completion of course, the student will be able to:

- CO1: Write, compile and debug programs in C language and use of different data types in a C program.
- CO2: Design programs involving decision structures, loops, functions, arrays and strings.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs /PSOs
CO1	PO2,PO3,PO5/ PSO1,PSO3
CO2	PO2,PO4, PO5,PO6,PO8, PO11/ PSO1,PSO2,PSO3,PSO4

COURSE STRUCTURE

PhD

COMPUTER SCIENCE & ENGINEERING

Under

Choice Based Credit System (CBCS)

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1	PCSE0001	Theory of Computation	4	0	0	4	4
2	PCSE0002	Software Engineering Methodologies	4	0	0	4	4
3	PCSE0003	Advanced Concepts in Data Mining	4	0	0	4	4
4	PCSE0004	Advanced Concepts in Networking	4	0	0	4	4
5	PCSE0005	Probability and Stochastic Processes	4	0	0	4	4
6	PCSE0006	Mobile Ad-hoc Networks	4	0	0	4	4
7	PCSE0007	Intelligent Systems	4	0	0	4	4
8	PCSE0008	Information Retrieval	4	0	0	4	4
9	PCSE0009	Image Processing and Analysis	4	0	0	4	4
10	PCSE0010	Design of Distributed Systems	4	0	0	4	4
11	PCSE0011	Computer Vision	4	0	0	4	4
12	PCSE0012	Wireless Sensor Networks	4	0	0	4	4
13	PCSE0013	Software and Service Oriented Architecture	4	0	0	4	4
14	PCSE0014	Pattern Recognition	4	0	0	4	4
15	PCSE0015	High Performance Computing	4	0	0	4	4
16	PCSE0016	Web Mining	4	0	0	4	4
17	PCSE0017	Machine Learning	4	0	0	4	4

PCSE0001: THEORY OF COMPUTATION

Objective: *Make students understand the fundamental questions of computer science:*

- *What problems can be solved by a computation?*
- *How hard is it to compute solutions?*
- *How can we express computation?*

Develop students' ability to understand and conduct mathematical proofs for computation and algorithms.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Chomsky Hierarchy of Grammars and the corresponding acceptors, Decidability – Decidable languages, The Halting Problem, Undecidable Problems about Turing Machines, Post's Correspondence Problem, Reducibility, Self-reference and the Recursion Theorem.	18
II	**Complexity theory** - Measuring Complexity, Nontrivial examples of polynomial-time algorithms, The concept of a reduction, P, NP, and NP-completeness; the Cook-Levin Theorem, The P versus NP problem and why it's hard. **Introduction to Cryptography** - Perfect secrecy and its limitations, Computational Approach to Cryptography, Computational security, one-way functions and pseudorandom generators, Pseudorandom generators from one-way permutations.	17
III	Probabilistic Turing machines and their examples, One-sided and "zero-sided" error: RP, coRP, ZPP. Trapdoor one-way functions, Zero Knowledge Proofs, some applications - Pseudorandom functions, tossing coins over the phone and bit commitment, Secure multiparty computations, Lower bounds for machine learning. Probably approximately correct (PAC) learning, Introduction to Quantum, Quantum Mechanics and BQP.	17

References:

- Moore, Cristopher, and Stephan Mertens. The Nature of Computation. Oxford University Press, 2011. ISBN: 9780199233212.
- Sipser, Michael. Introduction to the Theory of Computation., 2005. ISBN: 9780534950972.
- Arora, Sanjeev, and Boaz Barak. Computational Complexity: A Modern Approach. Cambridge University Press, 2009. ISBN: 9780521424264.

Focus: This Course focuses on Employability under CO1,CO2.

Outcome:

On successful completion of this course, students should be able to:

- CO1: Design, manipulate, and reason about formal computational models.
- CO2: Describe the limitations of different types of computing devices.
- CO3: Identify relations between classes of computational problems, formal languages, and computational models
- CO4: Account for the inherent complexity of many computational problems of practical importance
- CO5: Conduct formal reasoning about machines, problems and algorithms, including reduction-based proof

PCSE0002: SOFTWARE ENGINEERING METHODOLOGIES

Objective:*To understand the concepts and methods required for the development of large software intensive systems. Further, to provide an account of validation of various systems through formal methods.*

Credits: 04 **L–T–P : 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Motivation –Software Attributes – Complexity - Software Metrics- Software Process, Requirement Engineering, Formal requirement specification, requirement modeling and specification Design Metrics and Configuration Management. Formal Specification and program verification, Software Process, Requirement Engineering, Formal requirement specification, requirement modeling and specification.	18
II	**Software Design Patterns** Issues in software design: modularity based cohesion & coupling Function oriented analysis & design. Software Architecture description languages - Product-line architectures; Component based development **Software Quality Engineering** Testing Techniques – Test Case Generation, Software Maintenance schemes Software testing: strategies and assessment, COTS, Software reliability metrics & modeling, Software quality: models and assurance framework, Software Maintenance.	17
III	**Introduction to formal methods** Formal Specifications Techniques – Verification and Validation – Theorem Provers - Model checking – Temporal logics – CTL & LTL and model checking **Software Metrics** - COTS Integration - Distributed, Internet-scale and Web-based Software Engineering **Empirical Studies of Software Tools and Methods** Software Reengineering - Software Reuse - Software Safety - Enterprise Architectures, Zachman's Framework; Architectural Styles.	17

References:

- Ghezzi, Jazayeri, Mandrioli, (2002) "*Fundamentals of Software Engineering*", 2/E,Pearsonducation.
- Ian Sommerville (2006), "*Software Engineering*", 6/E,Pearson Education.
- Roger S Pressman (2005), "*Software Engineering – A Practitioner's Approach*" , 6/E,MGH,
- Schmidt, Stal, Rohnert, and Buschmann (2000), "*Pattern-Oriented Software Architecture*" Volume 2: Patterns for Concurrent and Network ed Objects", Wiley
- Len Bass, Paul Clements, Rick Katzman, Ken Bass (2003), "*Software Architecture in Practice*", 2/E, Addiwon –Wesley Professional.

Focus: This Course focuses on Employability under CO1,CO2,CO4

Outcome:

- CO1: Develop, maintain and evaluate large-scale software systems
- CO2: Produce efficient, reliable, robust and cost-effective software solutions
- CO3: Critically evaluate assumptions and arguments
- CO4: Apply the principles, tools and practices of IT project management
- CO5: Manage time, processes and resources effectively by prioritizing competing

demands to achieve personal and team goals

- CO6: Understand and meet ethical standards and legal responsibilities
- CO7: Rapidly learn and apply emerging technologies
- CO8: Understand the basic models of Software Quality and maintenance.

PCSE0003: ADVANCED CONCEPTS IN DATA MINING

Objective:

- *To understand the advanced principles, concepts and applications of data mining*
- *To introduce the task of data mining as an important phase of knowledge recovery process.*
- *Analyze the data for various applications.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction of Data Mining:** Fundamentals, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining, Data Mining Primitives. **Association Rules:** Basic Concepts, Apriori Algorithm, Data Formats for Association Rule Mining, Mining with Multiple Minimum Supports- Extended Model and Mining Algorithm, Mining Class Association Rules- Problem Definition and Mining Algorithm. **Sequential Patterns:**Basic Concepts,Mining Sequential Patterns Based on GSP, GSP Algorithm, Mining Sequential Patterns Based on PrefixSpan-PrefixSpan Algorithm,Generating Rules from Sequential Patterns-Sequential Rules and Label Sequential Rules.	18
II	**Supervised Learning:**Basic concepts. **Decision Tree Induction**: Learning Algorithm, Impurity Function, Classifier Evaluation- Evaluation Methods, Precision, Recall, F-score and Breakeven Point. **Classification Based on Associations:**Classification using Class Association rules, Class Association Rules as Features, **Naïve Bayesian Classification**: Basic Concepts, Naïve Bayesian Text Classification,Probabilistic Framework, Naïve Bayesian Model. **Support Vector Machines**: Linear SVM, Nonlinear SVM, K-Nearest Neighbor Learning.	17
III	**Unsupervised Learning:**Basic Concepts, K-means Clustering- K-means Algorithm, Disk Version of the K-means Algorithm. Representation of Clusters- Common Ways of Representing Clusters and Clusters of Arbitrary Shapes. **Hierarchical Clustering:**Single-Link Method, Complete-Link Method. **Distance Functions:** Numeric Attributes, Binary and Nominal Attributes, Text Documents, Data Standardization. Handling of Mixed Attributes,Which Clustering Algorithm to Use, Cluster Evaluation. **Partially Supervised Learning:** Learning from Labeled and Unlabeled Examples,EM Algorithm with Naïve Bayesian Classification,Co-Training, Self-Training.	17

References:

- Bing Liu, (2007) "*Web Data Mining*", First Edition,Springer.
- Jiawei Han and. MichelineKamber (2003) "*Data Mining – Concepts and Techniques*", 3rd Edition Morgan Kaufmann.
- Arun K Pujari (2010) "*Data Mining Techniques*", 2nd Edition University Press.

Focus: This Course focuses on Employability under CO2,CO3,CO4.

Outcome:

- On successful completion of this course, students should be able to:
- CO1: Understand the concept of data warehouse and data mining.
- CO2: Apply the concept of data warehouse and data mining in real-life applications.
- CO3: Apply the principle algorithms used in modern machine learning.
- CO4: Apply the information theory and probability theory to get the basic theoretical results in Advanced Data Mining.
- CO5: Apply Advanced Data mining algorithms to real datasets, evaluate their performance and appreciate the practical issues involved.
- CO6: Implement supervised algorithms on data set.
- CO7: Implement unsupervised algorithms on data set.
- CO8: Implement ensemble based algorithms on data set.

PCSE0004: ADVANCED CONCEPTS IN NETWORKING

Objective*: To make students understand the protocols, algorithms and tools needed to support the development and delivery of advanced network services over networks.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:**Networking overview, MAC layer issues, Ethernet 802.3, ARP, IP addressing and Subnetting, NAT and PAT, Variable Length Subnet Masking, CIDR **Advanced routing in the Internet and traffic engineering:**Intra domain routing: OSPF and IS-IS, Inter domain routing: BGP, Traffic Engineering **MPLS network**: MPLS basics, MPLS signaling, MPLS VPN **Internet multicasting:**IP multicasting, Application layer (Overlay) multicasting	18
II	**TCP connection establishment and termination**: Sliding window concepts, other issues: wraparound, silly window syndrome, Nagle's algorithm, adaptive retransmission, TCP extensions. **End-to-End Congestion Control:** Tahoe, Reno, Vegas, **Network based congestion control:** RED and ECN, Multicast congestion control. **Multimedia networking:**Introduction to multimedia networking, Video streaming over the Internet. **Internet QoS:**QoS fundamentals, Internet Differentiated services, Internet Integrated Services.	17
III	**Peer-to-Peer networks and applications:** Peer-to-Peer file sharing networks, Peer-to-Peer streaming networks, Concept of overlays, Unstructured Overlays: Gnutella, Concepts of Distributed Hash Table, Structured Overlays: Chord, CAN, Pastry. **Wireless mobile networks:**Introduction to wireless networks, Wireless LAN, Cellular Networks, Mobile IP	17

References:

- Peterson and Davie (2011) "*Computer Networks: A Systems Approach*", 5th Ed.Morgan Kauffman.
- Kurose and Ross (2011) "*Computer Networking: Top Down Approach*", 6th Ed. Pearson Education,

Reading List

- V. Paxson. "End – to - end Internet packet dynamics," in IEEE/ACM Transactions on Networking, Vol. No. 3, June, 1999.
- W. Stevens, "TCP Slow Start, Congestion Avoidance, Fast Retransmit, and Fast Recovery Algorithms," RFC2001.
- K. Fall and S. Floyd, "Simulation - based comparison of Tahoe, Reno, and SACK TCP," Computer Communication Review, vol. 26, pp. 5 - 21, July 1996.
- L. Brakmo and L. Peterson, " TCP Vegas: End – to - End Congestion Avoidance on a Global Internet," IEEE Journal on Selected Areas in Communications, 13(8), October 1995, 1465 -- 1480.
- A. Rowstron, P. Druschel,"Pastry: Scalable, decentralized object location and routing for large - scale peer – to - peer systems". Middleware, 2001, 329—350.

Focus: This Course focuses on Employability under CO1,CO5,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand and explain Data Communications System and its components.
- CO2: Identify the different types of network devices and their functions within a network.
- CO3: Understand and building the skills of subnetting and routing mechanisms.
- CO4: Differentiate among flow control, congesting control and congestion avoidance.
- CO5: Demonstrate the different congestion control mechanism.
- CO6: Calculate congestion window size (cwnd) in TCP congestion mechanism.
- CO7:Understand and analyze the challenges of P2P networks and wireless networks.
- CO8: Explain the limitations of wireless networks.

PCSE0005: PROBABILITY & STOCHASTIC PROCESSES

Objective: *To introduce the concepts of probability and stochastic processes and illustrate these concepts with engineering applications to support other courses and research in computer engineering.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Basic Probability**: Introduction, definitions of probability, set theory, axioms of probability, Conditional probability, Total probability and Bayes' theorem. **Random Variables:** Definition, Cumulative Distribution Function (CDF), continuous, discrete and mixed Random Variables, Probability Density Function (PDF), Probability Mass Function (PMF).	18
II	**Properties of Random Variables**: Moments of Random variables: Mean and varience of random variable, Coefficients of variation, Skewness and kurtosis, Moments, Covariance and correlation coefficient. Properties of Distribution Functions, **Specific Random Variables**: Gaussian, Exponential, Rayleigh, Uniform, Binomial and Poisson Distributions. **Hazard Rate**: Definition, hazard rate of Exponential distribution, Gamma distribution, Weibull distribution	17
III	**Stochastic Processes**: Definition and Classification of Stochastic Processes, Poisson process, Birth and Death Process, Applications to Queues, Discrete Time Markov Chains**,** Limiting Distributions – Theory of M/M/1 and M/M/m queues – Little's Theorem	17

Text Book:

- Kishore S. Trivedi, *"Probability and Statistics with Reliability, Queuing and Computer Science Applications*" Wiley

References:

- Papoulis, S. U. Pillai, "*Probability, Random Variables and Stochastic Processes*", Tata McGraw Hill
- A L Garcia, "*Probability and Random Process for Electrical Engineers*", Pearson Education
- R. M. Gray, L. D. Davisson (2004), "*An Introduction to Statistical Signal Processing*", Cambridge University Press.
- H. Stark and J. W. Woods, "*Probability and Random Processes with Applications to Signal Processing* ", Pearson Education.
- P.Z. Peebles, "*Probability, Random variables and Random signal principles*", Tata McGraw Hill
- S L Miller, D G. Childers, "*Probability and Random Processes*", Academic press.
- Y. Viniotis, "*Probability and Random Processes for Electrical Engineers*", McGraw Hill.

Focus: This Course focuses on Employability and Skill Development under CO1,CO3,CO4.

Outcome: After completion of course, the student will be able to:

- CO1: have a general overview of statistical methods.
- CO2: know the principle definitions, fundamental theorems, and important relationships in statistics.
- CO3: Understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.
- CO4: Understand how random variables and stochastic processes can be described and analyzed
- CO5: Characterize probability models and function of random variables based on single & multiples

random variables.

- CO6: understand the role of probability theory as well as the concept of random variables and stochastic processes in information and communication technology.
- CO7: having competence in applying statistical methods to solve basic problems in information and communication technology.
- CO8: Understand the classifications of random processes and concepts such as strict stationarity, wide-sense stationarity and ergodicity.

PCSE0006:MOBILE AD-HOCNETWORKS

Objective*: This course will enable the students to understand the detailed concept related to Mobile Ad-hoc Networks.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Ad Hoc Wireless Networks:** Issues in Ad Hoc Wireless Networks, Ad Hoc Wireless Internet; **MAC Protocols for Ad Hoc Wireless Networks:** Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols; **Routing Protocols for Ad Hoc Wireless Networks:** Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Power Aware Routing Protocols.	18
II	**Multi cast routing in Ad Hoc Wireless Networks:** Issues in Designing a Multicast Routing Protocol, Classifications of Multicast Routing Protocols, Energy Efficient Multicasting, Multicasting with Quality of Service Guarantees, Application Dependent Multicast Routing; **Transport Layer:** Issues and Design Goals, Split TCP, Ad-Hoc TCP, TCP-Bus	17
III	Key Management. Secure Routing in Ad Hoc Wireless Networks **Energy Management in Ad Hoc Wireless Networks**: Classification of Energy Management Schemes, Transmission Power Management Schemes, System Power Management Schemes. **QoS in Ad-hoc Networks**: Issues, PHY, MAC, Network Layer Solutions Cross Layer Design	17

References:

- C S. Ram Murthy, B. S. Manoj (2005), "*Ad Hoc Wireless Networks: Architectures and Protocols*", Second Edition, Prentice Hall of India.
- R. Hekmat (2006), "*Ad hoc Networks: Fundamental Properties and Network Topologies*", First Edition, Springer.
- B. Tavli and W. Heinzelman (2006), "*Mobile Ad Hoc Networks: Energy Efficient Real Time Data Communications*", First Edition, Springer.
- G. Anastasi, E. Ancillotti, R. Bernasconi, and E. S. Biagioni (2008) "*Multi Hop Ad Hoc Networks from Theory to Reality*", Nova Science Publishers.

Focus: This Course focuses on Employability under CO2,CO4,CO5,CO8.

Outcome: At the end of this course the students will be able to:

- CO1: Understand the need for ad hoc networks.
- CO2: Explain the constraints of physical layer that affect the design and performance of ad hoc network.
- CO3: Understand the concepts of protocols required for wired network may not work for wired network at MAC, Network and Transport Layer.
- CO4: Explain the operations and performance of different MAC layer protocols.
- CO5: Explain the different routing protocols proposed for ad hoc networks.

- CO6: Understand the basics of unicast and multicast routing protocols.
- CO7: Understand security issues and QoS requirements in MANETs.
- CO8: Explain about the energy management in adhoc networks.

PCSE0008: INFORMATION RETRIEVAL

Objective*: The objective of the course is to introduce students to the theoretical basics of information retrieval (IR).*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Concepts, Retrieval Process **Modeling** – A Formal Characterization of IR Models, Classic Information Retrieval (Boolean model, Vector Model, Probabilistic Model), Alterative Set Theoretic Models, Alternative Algebraic Models (Generalized Vector Space Model, Latent Semantic Indexing Model).	18
II	**Query Languages and Operations:** Keyword based Querying, Pattern Matching, Structural Queries, User Relevance Feedback. **Text Operations:** Document Preprocessing, Document Clustering, Text Compression. **Evaluation in Information Retrieval:** Retrieval Performance Evaluation Recall, Precision, Mean average Precision, F-Measure, User Oriented Measures, Discounted Cumulated Gain. TREC Web Collections.	17
III	**Searching the Web:** Characterizing the web, Crawling the Web, Mercator: A Scalable, Extensible Web Crawler, Parallel Crawlers, Different Types of Web Crawler, Anatomy of a Large-Scale Hypertextual Web Search Engine, Page Rank Algorithm. **IR Applications:** Summarization and Question Answering.	17

References:

- Ricardo Baeza-Yate, Berthier Ribeiro-Neto, (2011) "*Modern Information Retrieval*",Second Edition, AddisonWesly.
- G. G. Chowdhury (2003) "*Introduction to Modern Information Retrieval*", Second Edition, Neal-Schuman Publishers.
- David A. Grossman, Ophir Frieder, (2004) "*Information Retrieval: Algorithms, and Heuristics*", Springer.

Focus: This Course focuses on Employability under CO2,CO6,CO7.

Outcome: At the end of this course the students will be able to:

- **CO1:** Gain an understanding the basic concepts and techniques in Information Retrieval
- **CO2:**Apply different information retrieval techniques in real life applications.
- **CO3:** Understand the issues involved in representing and retrieving documents.
- **CO4:**Understand the latest technologies for linking, describing and searching the Web. - Understand the relationship between IR, hypermedia, and semantic models.
- **CO5:**Be able to apply and implement techniques for the preprocessing needed for information retrieval systems and can be able to develop a small information retrieval system.
- **CO6:**Apply the different evaluation strategies to the retrieved results for computing the efficiency and accuracy of the information retrieval model.

- **CO7:**Apply IR techniques to XML retrieval and develop retrieval system for web search tasks
- **CO8:**Demonstrate similarity computation for document retrieval.

PCSE0009: IMAGE PROCESSING AND ANALYSIS

Objective*: To cover the basic theory and algorithms that are widely used in digital image processing and analysis.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Digital Image Fundamentals:** Image sampling & quantization; Basic relationships between pixels, Some mathematical tools used in digital image processing. **Image perception:** Light, luminance, brightness and contrast, Human Visual System, Colour representation, Chromaticity diagram, Colour Coordinate Systems. **Image Enhancement:** Overview, Contrast Intensification, Smoothing, Sharpening, Basic intensity Transformation functions, Histogram processing, Spatial filters, Image Restoration	18
II	**Image Transforms:** Discrete Fourier Transform, DCT Transform, KL Transform, Wavelet Transform. Image Enhancement in Frequency Domain **Image Compression:** Fundamentals, Lossless Compression: Huffman Coding, Arithmetic Coding, Run-length Coding. Lossy Compression: JPRG Coding. **Image Registration:** Geometric Transformation, Registration by Mutual Information Maximization.	17
III	**Image Analysis:** Fundamental concepts, Segmentation: Region extraction, Pixel based approach, Thresholding, Region based approach. Canny Edge Detection, **Feature Extraction:** Representation, Topological Attributes, Geometrical Attributes, Spatial Moments, Boundary based Description, Region based Description, and Intensity based Description. **Object Recognition:**Patterns and pattern classes, Recognition based on decision-theoretic methods, structural methods.	17

References:

- R. C. Gonzalez and R.E. Woods, (2011) "*Digital Image Processing*", Third Edition, Prentice Hall.
- BhabatoshChanda, D. Dutta Majumder, (2013) "*Digital image processing and analysis*, Second Edition, PHI.
- Anil K. Jain, (2011) "*Fundamentals of Digital Image Processing*"**,** Prentice-Hall.

Focus: This Course focuses on Employability under CO1,CO2,CO4.

Outcome:

- CO1: Understand the need for image transforms and their properties.
- CO2: Develop any image processing application.
- CO3: Learn different techniques employed for the enhancement of images.
- CO4: Learn the spatial and frequency domain techniques of image compression.
- CO5: Learn different feature extraction techniques for image analysis and recognition
- CO6: Learn different causes for image degradation and overview of image restoration techniques.
- CO7: Analyze images in the frequency domain using various transforms.
- CO8: Implement the image processing techniques in real world problems.

PMCSC0010: DESIGN OF DISTRIBUTED SYSTEMS

Objective: *To understand the fundamental principles, architectures, algorithms and programming models used in distributed systems and their extension in grid and cloud computing.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction, Types, Design Issues, Models,Theoretical foundations of DS, Case Study of Amobea. **Distributed Mutual Exclusion:**Classification, Requirements, Performance Measurement, Non-Token Based Algorithm & Token Based Algorithm, Shared Memory based Mutual Exclusion **Communication in Distributed System:** Communication Between Distributed Objects, Events, Inter Process Communication- RPC, Distributed Objects and Middleware –Overview of trends. Challenges and Opportunities. **Distributed File Systems** –Introduction, Issues, Mechanism for building distributed file systems, Reliability & Performance in traditional DFS, Case Study – AFS, NFS, CODA	18
II	**Failure Recovery:**Introduction, types, Recovery in concurrent and replicated distributed database system, Checkpoint Based Recovery **Fault Tolerance**: Issues, Commit Protocols, Voting Protocols **Distributed Scheduling** – Issues in Load Distributing, Components, Stability, Load Distributing algorithm, Performance Comparison, Task Migration and issues **Distributed shared memory**-Architecture & Motivation, Memory coherence, Coherence Protocol, Design Issues Case Study- IVY	17
III	**Distributed Web-Based Systems** – Architecture, Processes, Naming, Synchronization, Consistency and Replication **Distributed Coordination-Based Systems-** Introduction To Coordination Models, Architectures, Processes, Communication **Grid Computing** – Definition, Benefits, Issues, Types of Resources, Scheduling, reservation, and scavenging, Grid architecture models, Grid topologies, Case Study – Globus Toolkit **Cloud Computing** – Definition, Properties, Characteristics & Disadvantages, Cloud Computing Architecture, Service Models, Deployment Models, Resource Virtualization, Case Study – Amazon EC2	17

Text Book:

- Singhal& Shivaratri (2001) *"Advanced Concept in Operating Systems"*, McGraw Hill.

References:

- Coulouris, Dollimore, Kindberg (2011) *"Distributed System: Concepts and Design"*, Pearson Ed.Gerald Tel *"Distributed Algorithms"*, Cambridge University Press.
- Tannenbaum *(2004) "Distributed Systems: Principles and Paradigms"*, Pearson Education.

Focus: This Course focuses on Employability under CO2,CO4,CO6.

Outcome:

- CO1: Understand basic elements and concepts related to distributed system technologies; and core architectural aspects of distributed systems.
- CO2:Identify the designing principles of distributed algorithms for different primitives like mutual exclusion, deadlock detection, and agreement.
- CO3:Understand principle behind IPC and use various interposes communication techniques, such as remote method invocation, remote events for building distributed systems.
- CO4:Introduce the concepts of distributed file system with its architecture and components along

with case studies.

- CO5: Distinguish the main failure types in a Distributed System and specify algorithms for achieving fault tolerance and error recovery within such a system.
- CO6:Understand how balancing of resources is done; issues, components and algorithms for load balancing in distributed environment.
- CO7:Applying Grid and Web based techniques to support Distributed Systems.
- C 8. Applying Cloud based techniques to support Distributed Systems.

PMCSC0011: COMPUTER VISION

Objective: *To introduce the principles, models and applications of computer vision. To develop an appreciation for various issues in the design of computer vision and object recognition systems*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:**Overview to Computer Vision, Image formation – Geometric primitives and transformations, Photometric Image formation. **Digital Camera:**Sampling & aliasing, Colour, Compression, Camera model &caliberation, Epipolar Geometry, Stereopsis. **2D Shape –** Hough transform, Shape numbers, Pyramids, Quad Trees, Medial Axix Transform.	18
II	**Recognition:** Detectors and Descriptors,clustering (K-Mean and Mean Shift), Interest Point Detection, Harris Corner Detector, SIFT, Template Matching, Detection with sliding windows: Viola Jones, Object recognition (Eigenfaces, Active appearance models). **Classification:**K-nearest Neighbours Algorithm, Statistical Classification, Bag-of-Words Models, Overview of methods for building Classifies, a part-based generative model (Constellation model) and a part-based discriminative model (Latent SVM),	17
III	**Motion Analysis:** Motion estimation using Optic Flow, Video Change Detection, moving object detection - Background Subtraction approach, moving object detection using Gaussians Mixture Model (GMM) approach. Object Tracking, Kernel (Mean Shift) based Object Tracking, Motion Models to aid tracking (Kalman Filtering, particle filtering), Data Association, Applications of Object Tracking.	17

References:

- Richard Szeliski (2010) "Computer Vision: Algorithms and Applications", Springer.
- D.A. Forsyth and J. Ponce (2002), "Computer Vision: A Modern Approach", Prentice Hall.
- Milan Sonka, Vaclav Hlavae, Roger Boyle (2008),"Image Processing, Analysis and Machine Vision", Second Edition, Thomson.
- R. Hartley, and A. Zisserman (2004), "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press.
- R.O. Duda, P.E. Hart, and D.G. Stork (2000), "Pattern Classification" (2nd Edition), Wiley-Interscience.

Focus: This Course focuses on Employability under CO1,CO2,CO5,CO6,CO8.

Outcome:

- CO1: Understand the basic knowledge, and methods of human and computer vision systems.
- CO2: Identify, formulate and solve the image formation and image modelling process.
- CO3: Analyze, evaluate and test existing practical computer vision systems.
- CO4: Implement the working of live computer vision system effectively.
- CO5: Apply theoretical and practical knowledge to identify the novelty and practicality of proposed computer vision methods.
- CO6: Design and develop practical and innovative computer vision applications or systems.
- CO7: Able to conduct real implication image processing and deep learning methods.
- CO8: Analyze and design algorithms for computer vision applications.

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PMCSC0012: WIRELESS SENSOR NETWORKS

Objective:*To make students understand the protocols, algorithms and tools needed to support the deployment and functionality of wireless sensor networks.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Applications and Design Model:** Examples of available sensor nodes, Sample sensor networks applications, Design challenges, Contemporary network architectures, Operational and computational models, Performance metrics, Software and hardware setups. **Network Bootstrapping:** Sensor deployment mechanisms, Issues of coverage, Node discovery protocols **Physical and Link layers:** Radio energy consumption model, Power Management, Medium access arbitration: Low duty cycle protocols and wakeup concepts, Contention-based protocols, Schedule-based protocols, Optimization mechanisms	18
II	**Localization and Positioning:**Properties of positioning, Possible approaches, Mathematical basics for the lateration problem, Single-hop localization, Positioning in multi-hop environments, Impact of anchor placement. **Topology control:** Motivation and basic ideas, Flat network topologies, Hierarchical networks by dominating sets, Hierarchical networks by clustering, Combining hierarchical topologies and power control, Adaptive node activity. **Naming and Addressing:** Address and name management in wireless sensor networks, Assignment of MAC addresses, Distributed assignment of locally unique addresses, Content-based and geographic addressing.	17
III	**Routing protocols:** The many faces of forwarding and routing, Gossiping and agent-based unicast forwarding, Energy-efficient unicast, Broadcast and multicast, Geographic routing, Coping with energy constraints, Mobile nodes. **Data-centric and content-based networking:**Introduction, Data-centric routing, Data aggregation, Data-centric storage. **Dependability Issues:**Security challenges, Threat and attack models, Quality of service provisioning, Time Synchronization: Introduction to the time synchronization problem, Protocols based on sender/receiver synchronization, Protocols based on receiver/receiver synchronization, Supporting fault tolerant operation.	17

Reference s:

- Dorothea Wagner and Roger Wattenhofer (2007), "*Algorithms for Sensor and Ad Hoc Networks, Advanced Lectures*", Lecture Notes in Computer Science 4621
- WaltenegusDargie, Christian Poellabauer (2010), "*Fundamentals of Wireless Sensor Networks: Theory and Practice*", John Wiley & Sons
- Carlos De MoraisCordeiro, Dharma Prakash Agrawal (2011), "*Ad Hoc and Sensor Networks: Theory and Applications*", World Scientific
- Holger Karl, Andreas Willig (2005) "*Protocols and Architectures for Wireless Sensor Networks*", Wiley Publications

- Cauligi S. Raghavendra, Krishna Sivalingam, Taieb M. Znati (2005) "*Wireless Sensor Networks*", Springer,

Focus: This Course focuses on Employability under CO1,CO2,CO8.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of wireless sensor networks, sensing, computing and communication tasks
- CO2: Understand the Sensor management, sensor network middleware, operating systems.
- CO3: Analyze the assess coverage and conduct node deployment planning,
- CO4: Devise appropriate data dissemination protocols and model links cost,
- CO5: Determine suitable medium access protocols and radio hardware.
- CO6: Understand the architectures, features, and performance for wireless sensor network systems and platforms
- CO7: Identify quality of service, fault-tolerance, security and other dependability requirements and conduct trade-off analysis between performance and resources.
- CO8: Evaluate the performance of sensor networks and identify bottlenecks.

PMCSC0013: SOFTWARE AND SERVICE ORIENTED ARCHITECTURE

Objective:*To understand basic concepts, theories, and techniques used in service-oriented architecture, alongwith governance strategies and trends in SOA.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Software Architecture – Types of IT Architecture, SOA Evolution, Key components, perspective of SOA, Enterprise-wide SOAArchitecture, EnterpriseApplications,Solution Architecture for enterprise application Software platforms for enterprise Applications, Patterns for SOA, SOA programming models.	18
II	Service-oriented Analysis and Design – Design of Activity, Data, Client and business process services. Technologies of SOA – SOAP, WSDL. Service integration with ESB Web Services and Contemporary SOA- Message exchange patterns, Service activity, coordination. Atomic transactions, Business activities, Orchestration and Choreography- Issues Introduction to XML – Overview and Security,	17
III	Introduction to Web Services and Security, SOA implementation and Governancestrategy, trends in SOA, event-driven architecture, software as a service. SOA Delivery Strategies- SOA delivery lifecycle phases. Transaction processing – paradigm, protocols and coordination, transaction specifications, SOA in mobile, research issues in SOA	17

References:

- Shankar Kambhampaly (2008), "*Service –Oriented Architecture for Enterprise Applications*", Wiley India Pvt. Ltd.
- Eric Newcomer, Greg Lomow, "*Understanding SOA with Web Services*", PearsonEducation.
- Mark O' Neill, et al. , "*Web Services Security*",Tata McGraw-Hill Edition, 2003.
- Thomas Erl(2008)," *Service-Oriented Architecture: Concepts, Technology & Design*", Pearson Education Pvt. Ltd.
- Thomas Erl (2007), "*SOA Principles of Service Design*", Pearson Exclusives.
- Thomas Erl and Grady Booch, (2008) "*SOA Design Patterns*", Prentice Hall.

Focus: This Course focuses on Employability under CO1,CO2,CO7,CO8

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand primary concepts of SOA
- CO2: Design the software Platforms using SOA
- CO3: Understand Web Services and Contemporary SOA
- CO4: Understand Security issues of SOA
- CO5: Implement XML in designing SOA
- CO6: Know the integration of SOA technological points with Web Services.
- CO7: Implement SOA in development cycle of Web Services
- CO8: Implement SOA in Transaction Processing

PMCSC0014: PATTERN RECOGNITION

Objective: *Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.	18
II	**Statistical Patten Recognition:** Bayesian Decision Theory, Classifiers, Normal density and discriminant functions, **Parameter estimation methods:** Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.	17
III	**Nonparametric Techniques:** Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification. **Unsupervised Learning & Clustering:** Criterion functions for clustering, Clustering Techniques: Iterative square - error partitional clustering – K means, agglomerative hierarchical clustering, Cluster validation.	17

References:

- Richard O. Duda, Peter E. Hart and David G. Stork (2006), "*Pattern Classification*", 2nd Edition, John Wiley.
- C. M. Bishop (2009), "*Pattern Recognition and Machine Learning*", Springer.
- S. Theodoridis and K. Koutroumbas (2009), "*Pattern Recognition*", 4th Edition, Academic Press.

Focus: This Course focuses on Employability under CO1,CO4,CO6.

Outcome: After the completion of the course, the student will be able to:

- CO1: Understand a variety of pattern recognition algorithms, along with pointers on which algorithms work best under what conditions, so that students can make sound decisions on what approaches to take when faced with a real world problem.
- CO2: Understanding the various applications Pattern Recognition in real life applications.
- CO3 Formulate PR models based different classifiers.
- CO4: Apply the Statistical Patten Recognition methods for improving classification
- CO5: Identifying the parameter estimation methods for feature extraction.
- CO6:Analyze the non-parameter Techniques for Pattern classification.
- CO7:Design model based on Machine Learning to Pattern Classification.
- CO8:Analyze the use of Unsupervised Learning for pattern clustering.

PMCSC0015: HIGH PERFORMANCE COMPUTING

Objective:*This subject introduces students to the essential tools and techniques of high performance computing. The main objectives are to introduce students to different frameworks of parallel and distributed computing that they can use in their specific areas of interest. The students may learn to program multi-core processors as well as clusters of personal computers using the widely used computer languages.*

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Overview of Parallel Techniques:** Classification of Instruction Set Architectures, Instruction level, Thread level and Process level. **Pipelining**: Instruction and functional pipelines, Hazards in a pipeline,Branch prediction techniques; Superscalar Techniques. **Memory Hierarchies:** Basic hierarchical memory concepts,Cachedesign, Virtual memory design &uses, Memory hierarchy performance. **Parallel Programming Concepts:** Abstract Machine Models – RAM& PRAM, various parallel algorithms on them.	18
II	**Introduction:** Cloud Computing, Computing Platforms and Developments, Virtualization. **Cloud Computing Architecture:** Reference Model, Types of Cloud, Concurrent Computing, High Throughput Computing. **Cloud Applications:**Application in Industry, General Cloud Applications, Advanced Topics in Cloud Computing.	17
III	**Introduction**: Definition of Grid Computing, Grid Architecture Standard for Grid, Data Management in Grid, Grid Scheduling **Grid Security & Middleware:** Trust and Security in Grid, Grid Middle ware, Architectural Overview of Grid Projects. **Grid Computing Methods:** Monte Carlo Method, Partial Differential Equations, Some Grid Tool- Globus, glite.	17

References:

- John L Hennessy & David A, (2011) "*Patterson-Computer Architecture: A Quantitative Approach*", Morgan Kaufmann.
- Kai Hwang (2013) "*Advanced Computer Architecture*", Tata McGraw Hill Edition.
- RajkumarBuyya, Christian Vecchiola& S, ThamaraiSelvi (2013)" *Mastering Cloud Computing*", Tata McGraw Hill Edition.
- Fredric Magoules, Jie Pan, Kiat-An Tan &Abhinit Kumar (2007)"*Introduction to Grid Computing*", CRC Press, Taylor & Francis Group.

Focus: This Course focuses on Employability under CO2,CO4,CO7.

Outcome: At the end of this course the students will be able to:

- CO1:Understand architecture of computing technology.
- CO2: Design, formulate and implement high performance versions single threaded algorithms
- CO3: Demonstrate the architectural features of High performance computers
- CO4: Design programs to extract maximum performance in a multicore, shared memory execution environment processor.
- CO5: Design and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm.

- CO6: Administration, scheduling, code portability and data management in an HPC environment.
- CO7: Analyze the suitability of different HPC solutions to problems found in Computational Science.
- CO8: Implement parallel programs on different hardware architectures and software environments.

PMCSC0016: WEB MINING

Objective: *Introduce students to the basic concepts and techniques Web Mining for extracting knowledge from the web.*

Credits: 04 **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Concepts of Web Mining, Classification of Web Mining:Web Content Mining, Web Structure Mining, Web Usage Mining, Issues in Web Mining, Crawling the Web, Hyperlink Analysis, Basics of HTML, HTTP, HTTPS and scripting. **Web Content Mining:** document indexing and retrieval in the web environment, web documents categorization and clustering, Text and Web Page Pre- Processing.	18
II	**Web Structure Mining:** Anchor Text,Hyperlink Analysis, Static and Dynamic Hyperlinks, Web Graph, Web Search, Query Expansion, Primary web browsing (crawling), Link topology analysis. **Social Network Analysis:** Social Sciences and Bibliometry, Prestige, Centrality, Co- citation, PageRank and HITS, Stochastic HITS and Other Variants, Enhanced Models and Techniques, Avoiding Two- Party Nepotism, Outlier Elimination, Exploiting Anchor Text. **Evaluation of Topic Distillation**: HITS Algorithm.	17
III	**Web Usage Mining Process and Techniques:** Data collection and Pre Processing, Data modeling for web usage mining, Discovery and analysis of web usage patterns, Session and visitor analysis, Cluster analysis and visitor segmentation. **Resource Discovery:**Collecting important pages preferentially, crawling as guided search in a graph, Keyword-Based graph search, Similarity search using Link Topology. **The Future Of Web Mining:** Natural Language Processing, Lexical Networks and Ontologies, Part- of- Speech and Sense Tagging, Parsing and Knowledge Representation, Profiles, Personalization, Collaboration, Opinion mining.	17

References:

- SoumenChakrabarti(2010) *“Mining the Web: discovering knowledge from hypertext data, Part 2”*, Morgan Kaufmann Publisher.
- Bing Liu (2007) “*Web Data Mining: exploring hyperlinks, contents, and usage data*”, Springer.
- Gordon Linoff and Michael Berry (2002) *“Mining the Web: Transforming Customer Data into Customer Value”*, John Wiley & Sons.
- C. Manning, P. Raghavan, and H. Schütze (2008) *“Introduction to Information Retrieval”*, Cambridge University Press.
- Ricardo Baeza-Yate, Berthier Ribeiro-Neto, (2011) “*Modern Information Retrieval*”, Second Edition, Addison Wesly.

Focus: This Course focuses on Employability under CO2,CO4,CO5,CO7.

Outcome: At the end of this course the students will be able to:

- CO1: Understand the fundamentals of Web Mining Principles for effective web information retrieval

- CO2: Understand the functionality of the various web mining components for knowledge discovery.
- CO3: Compare and evaluate different web mining techniques for structured, unstructured and semi structured data.
- CO4:Extract knowledge using web mining techniques for computing rank of the retrieved results.
- CO5:Acquire statistical techniques to analyze complex information from the content, structure and usages of the web application.
- CO6:Acquire statistical techniques to analyze complex information and social networks;
- CO7:Learn to critically read and connect a significant amount of scientific literature;Apply technical and analytic skills to develop a significant research project.
- CO8:Describe key concepts such as deep web, surface web, semantic web, web log, hypertext, social network, and evaluation measures such as precision and recall.
- CO9: Analyze and explain what web mining problems are satisfiably solved, what is worked upon at the research frontier and what still lies beyond the current state-of-the-art.

COURSE STRUCTURE

B. TECH

ELECTRONICS & COMMUNICATION ENGINEERING

Under

Choice Based Credit System(CBCS)

(w.e.f. 2020-21)

First Semester

S.No.	Code	Subject	L	T	P	C
1	BMAS0101	Engineering Mathematics- I	3	1	0	4
2	BPHS0002	Engineering Physics-I	3	1	0	4
3	BMEG0001	Basic Mechanical Engineering	3	1	0	4
4	BELH0001	English Language Skills for Communication – I	2	0	0	2
5	BECG0001	Electronics Engineering	3	1	0	4
6	BECG0800	Electronics Lab-I	0	0	2	1
7	BECG0801	Electronics Simulation Lab	0	0	2	1
8	BPHS0801	Engineering Physics Lab	0	0	2	1
9	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1
10	BMEG0801	Engineering Drawing	0	0	2	1
11	BELH0801	English Language Lab I	0	0	2	1
		Total				**24**

Second Semester

B.Tech.(ECE) Second Semester (Applicable for batch Admitted in 2018-19)

S.No.	Code	Subject	L	T	P	C
1	BMAS0102	Engineering Mathematics-II	3	1	0	4
2	BCHS0101	Engineering Chemistry	3	1	0	4
3	BCSC0001	Computer Programming	4	1	0	5
4	BEEG0001	Basic Electrical Engineering	3	1	0	4
5	BELH0002	English Language Skills for Communication-II	2	0	0	2
6	BEEG0800	Electrical Engineering Lab	0	0	2	1
7	BECG0002	Digital Electronics	3	1	0	4
8	BECG0802	Digital Electronics Lab	0	0	2	1
9	BCHS0801	Engineering Chemistry Lab	0	0	2	1
10	BCSC0800	Computer Programming Lab	0	0	2	1
11	BELH0802	English Language Lab – II	0	0	2	1
Total						**28**

Program Core (PC)
(Credits – 48)

S. No.	Code	SUBJECT	TEACHING SCHEME				CREDITS	HRS/WK	Prerequisite	Coe requisite
			L	T	P	J				
1	BECC0001	**Network Analysis and Synthesis**	3	1	0	0	4	4	N/A	N/A
2	BECC0002	**Electromagnetic Field Theory**	3	1	0	0	4	4	N/A	N/A
3	BECC0003	**Solid State Devices and Circuits**	3	1	0	0	4	4	N/A	N/A
4	BECC0004	**Signals and Systems**	3	1	0	0	4	4	N/A	N/A
5	BECC0005 /BECC0012	**Microprocessors and Applications/ Advanced Microprocessor**	3/ 4	0	0	0	3/4	3/4	N/A	Microprocessors Lab
6	BECC0800	**Microprocessors Lab**	0	0	2	0	1	2	N/A	N/A
7	BECC0006	**Analog Integrated Circuits**	3	0	0	0	3	3	SSDC	Electronics Lab-II
8	BECC0801	**Electronics Lab-II**	0	0	2	0	1	2	N/A	N/A
9	BECC0007	**Control Systems**	3	1	0	0	4	4	N/A	Control Systems Lab
10	BECC0802	**Control Systems Lab**	0	0	2	0	1	2	N/A	N/A
11	BECC0008	**Communication Engineering**	3	1	0	0	4	4	Signals and Systems	Communication Lab
12	BECC0803	**Communication Engineering Lab**	0	0	2	0	1	2	N/A	N/A
13	BECC0009	**Digital Communication**	3	1	0	0	4	6	Communication Engineering	Digital Communication Lab
14	BECC0804	**Digital Communication Lab**	0	0	2	0	1	2	N/A	N/A
15	BECC0010	**Digital Signal Processing**	3	1	0	0	4	4	Signals and Systems	Digital Signal Processing Lab
16	BECC0805	**Digital Signal Processing Lab**	0	0	2	0	1	2	N/A	N/A
17	BECC0011	**VLSI Design**	3	0	0	0	3	3	SSDC	CAD of Electronics Lab
18	BECC0806	**CAD of Electronics Lab**	0	0	2	0	1	1	N/A	N/A

Note:-L T P J C of 2 0 2 4 4 means the course has 2 Units of Class room Lecture, no Tutorial, 1 Unit of Lab work and 1 Unit of Project.

Program Elective(PE)
(Credits:26)

BOUQUET-I: COMMUNICATION ENGINEERING

Code	Courses	L	T	P	J	C	Prerequisite	Coe requisite
BECE0070	Simulation Lab-II	0	0	2	0	1	N/A	N/A
BECE0001	Random Variables and Stochastic Processes	3	0	0	0	3	Fundamentals of Probability	N/A
BECE0002	Antenna & Wave Propagation	3	0	0	0	3	EMFT	N/A
BECE0003	Data Communication and Networks	3	0	0	0	3	Digital Communication	N/A
BECE0004	Microwave Engineering	3	0	0	0	3	EMFT	N/A
BECE0071	Microwave Lab	0	0	2	0	1	N/A	N/A
BECE0005	Optical Communication	3	0	0	0	3	SSDC	N/A
BECE0072	Optical communication Lab	0	0	2	0	1	N/A	N/A
BECE0006	Wireless Communication	3	0	0	0	3	Digital Communication	N/A
BECE0007	Information Theory & Coding	3	0	0	0	3	Digital Communication	N/A
BECE0008	Multicarrier Communication	3	0	0	0	3	Digital Communication	N/A
BECE0073	Multicarrier Communication Lab	0	0	2	0	1	Digital Communication	N/A
BECE0086	Multicarrier Communication Projects	0	0	0	8	2	Digital Communication	N/A
BECE0009	Spread Spectrum System	3	0	0	0	3	Digital Communication	N/A
BECE0010	Satellite Communication	3	0	0	0	3	Digital Communication	N/A
BECE0011	Long Term Evolution	3	0	0	0	3	Wireless Communication	N/A

BOUQUET-II: SIGNAL AND IMAGE PROCESSING

Code	Courses	L	T	P	J	C	Prerequisite	Coe requisite
BECE0070	Simulation Lab-II	0	0	2	0	1	N/A	N/A
BECE0001	Random Variable and stochastic Process	3	0	0	0	3	Fundamentals of Probability	N/A
BECE0101	Fundamentals of Digital Image Processing	3	0	0	0	3	S&S	N/A
BECE0102	Digital Image Processing	3	0	0	0	3	S&S	N/A
BECE0171	Digital Image Processing Lab	0	0	2	0	1	S&S	N/A
BECE0186	Digital Image Processing Project	0	0	0	8	2	S&S	N/A
BECE0103	Bio-Medical Image Processing	3	0	0	0	4	S&S	N/A
BECE0104	Analog Signal Processing	3	0	0	0	3	SSDC,S&S	N/A
BECE0105	Adaptive Signal Processing	3	0	0	0	3	DSP, RV&SP	N/A
BECE0106	Bio-Medical Signal Processing	3	0	0	0	3	Digital Signal Processing	N/A
BECE0171	Bio-Medical Signal Processing Lab	0	0	2	0	1	Digital Signal Processing	N/A
BECE0107	Speech Processing	3	0	0	0	3	Adaptive Signal Processing	N/A
BECE0172	Speech Processing Lab	0	0	2	0	1	Adaptive Signal Processing	N/A

BOUQUET-III: VLSI

Code	Courses	L	T	P	J	C	Prerequisites	Coe requisite
BECE0070	Simulation Lab-II	0	0	2	0	1	N/A	N/A
BECE0001	Random Variable and stochastic Process	3	0	0	0	3	Fundamentals of Probability	N/A
BECE0201	Fundamentals of HDL Programming	3	0	0	0	3	DE	N/A
BECE0202	Digital System Design using HDL	3	0	0	0	3	DE	BECE0271
BECE0271	Digital System Design using HDL LAB	0	0	2	0	1	DE	N/A
BECE0286	Digital System Design using HDL PROJECT	0	0	0	8	2	DE	N/A
BECE0203	Analog VLSI Design	3	0	0	0	3	S&S	N/A
BECE0204	VLSI Testing And Testability	3	0	0	0	3	VLSI Design	N/A
BECE0205	Integrated Circuit Technology	3	0	0	0	3	VLSI Design	N/A
BECE0206	Fundamentals of Low-Power VLSI Circuits and Systems	3	0	0	0	3	VLSI Design	N/A
BECE0207	Low-Power VLSI Circuits and Systems	3	0	0	0	3	VLSI Design	N/A
BECE0272	Low-Power VLSI Circuits and Systems Lab	0	0	2	0	1	VLSI Design	N/A
BECE0287	Low-Power VLSI Circuits and Systems Project	0	0	0	8	2	VLSI Design	N/A
BECE0208	Fundamentals of RF Integrated Circuits	3	0	0	0	3	SSDC. Comm Engg.	N/A
BECE0209	RF Integrated Circuits	3	0	0	0	3	SSDC. Comm. Engg.	N/A
BECE0273	RF Integrated Circuits Lab	0	0	2	0	1	SSDC. Comm. Engg.	N/A
BECE0288	RF Integrated Circuits Project	0	0	0	8	2	SSDC. Comm. Engg.	N/A
BECE0210	Micro and Nano devices	3	0	0	0	3	SSDC	N/A

BOUQUET-IV: CONTROL AND EMBEDED SYSTEM

Code	Courses	L	T	P	J	C	Prerequisite	Coe requisite
BECE0070	Simulation Lab-II	0	0	2	0	1	N/A	N/A
BECE0001	Random Variable and stochastic Process	3	0	0	0	3	Fundamentals of Probability	N/A
BECE0301	Electronic Instruments and Measurements	3	0	0	0	3	N/A	N/A
BECE0302	Microcontrollers and Embedded Systems	3	0	0	0	3	Microprocessors	N/A
BECE0303	Embedded Systems Design	3	0	0	0	3	Microprocessors	N/A
BECE0371	Embedded Systems Lab	0	0	2	0	1	N/A	N/A
BECE0386	Embedded Systems Project	0	0	0	8	2	N/A	N/A
BECE0304	Intelligent System	3	0	0	0	3	Control System	N/A
BECE0305	Industrial Process Control	3	0	0	0	3	Control System	N/A
BECE0372	Industrial Process Control Lab	0	0	2	0	1	Control System	N/A
BECE0387	Industrial Process Control Project	0	0	0	8	2	Control System	N/A
BECE0306	Digital Control System	3	0	0	0	3	Control System and Signal systems	N/A
BECE0307	Modern control system						Control System	N/A
BECE0308	Industrial Automation	3	0	0	0	3	Digital Electronics. Control System	N/A
BECE0373	PLC Automation Lab	0	0	2	0	1	Digital Electronics. Control System	N/A
BECE0311	Adaptive Control	3	0	0	0	3	Control System	N/A

Project Work(PW)

S. No.	Code	SUBJECT	TEACHING SCHEME				CREDITS	Prerequisite
			L	T	P	J		
1	BECJ0950	**Mini Project-I**	**0**	**0**	**0**	**4**	**1**	**N/A**
2	BECJ0951	**Mini Project-II**	**0**	**0**	**0**	**4**	**1**	**N/A**
3	BEC0952	**Mini Project-III**	**0**	**0**	**0**	**8**	**2**	**N/A**
4	BECJ0971	**Project-I**	**0**	**0**	**0**	**12**	**3**	**144 Credits earned and CPI>=5.5**
5	BECJ0972	**Project-II**	**0**	**0**	**0**	**32**	**8**	**144 Credits earned and CPI>=5.5**
6	BECJ0991	Industrial Training	0	0	0	8	2	N/A

Mandatory Non Graded Courses (MNG)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS	PRE-REQUISITES
			L	T	P	J			
THEORY									
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
		TOTAL	**8**	**0**	**0**	**0**	**0**	**8**	

Basic Sciences (BS) & Humanities and Social Sciences (HS) (From Second Year Onwards)

S.No.	Code	Subject	Teaching Scheme				Credits	Contact (HR/WK)	Pre Requisites
			L	T	P	J			
THEORY									
1	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
2	BELH0003	English for Professional Purpose– I	2	0	0	0	2	2	
3	BELH0004	English for Professional Purpose– II	2	0	0	0	2	2	
4	BELH0006	Ethics & Values	2	0	0	0	2	2	
5	MBAC0005	Industrial & Management	3	0	0	0	3	3	
PRACTICALS									
6	BTDH0301	Soft Skills-I	0	0	2	0	1	2	
7	BTDH0302	Soft Skills-II	0	0	2	0	1	2	
8	BTDH0303	Soft Skills-III	0	0	8	0	4	8	
9	BTDH0304	Soft Skills-IV	0	0	8	0	4	8	
Total			**13**	**0**	**24**	**0**	**25**	**37**	

1.

BECG0001: ELECTRONICS ENGINEERING

Credits: 04 **L–T–P-J: 3–1–0-0**

Course Objectives

- Be familiar with the principle and theory of semiconductor materials.
- To facilitate understanding of Analog components such as PN Junction Diode, BJT, Operations Amplifiers.
- To facilitate understanding of Digital logic fundamentals and logic gates.

Module No.	Contents	Teaching Hours
I	**Transport phenomenon in semiconductors:** Semiconductor materials; Intrinsic and Extrinsic semiconductors; Mass-action law, Drift and diffusion of charge carriers. **Junction diodes:** P-N Junction diode: construction, operation & characteristics; Zener and Avalanche breakdown mechanisms; Diode resistance and capacitance **Diode applications:** Rectifiers: half wave, full wave : Centre-tapped and bridge type.; Filters; Clippers; Clampers; Voltage Multipliers; Zener diode as voltage regulator; Regulated power supply. **Bipolar Junction Transistor (BJT):** Bipolar junction transistor: construction & operation; CB ,CE, CC configurations & their Characteristics; Operating point; Transistor as a switch; Need of biasing;	20
II	**Bipolar Junction Transistor (BJT):** Biasing methods: fixed bias, emitter bias, potential divider bias, voltage feedback bias; Bias stabilization; Stability factor; **Field Effect Transistor (FET):** Construction, operation & characteristics of JFET; Shockley's equation; Depletion& Enhancement type MOSFET; Biasing of JFET:-fixed bias, self bias and voltage divider bias; Biasing of depletion type & enhancement type MOSFET. **Digital Electronics:** Number systems; Binary Addition & Subtraction;1's and 2's complement , Subtraction using 2's complement; Boolean algebra; Logic gates; Implementation of basic gates using universal gates; Realization of Boolean functions using basic & universal gates; Canonical forms(SOP & POS); Simplification of Boolean functions using Boolean postulates & K-map up to 4 variables with don't care condition. **Operational Amplifier (Op-Amp):** Operational amplifier: Block diagram, ideal and practical Op-Amp characteristics; Inverting, non-inverting and differential configurations (open loop and closed loop); Applications of Op-Amp as buffer, adder, subtractor, integrator and differentiator.	21

Text Book:

- Robert L. Boylestad and Louis sashelsky, "*Electronic devices and circuit theory*", Pearson Education/PHI, New Delhi.

Reference Books:

- Morris Mano, "*Digital design*", Pearson Education.
- R.A. Gayakwad, "*Op-amps & linear Integrated circuits*", PHI.
- R.J. Smith and R.C. Dorf, Circuits, "*Devices and System,*" Willey, 5th edition.

Course Outcomes: After successfully completing the course students will be able to:

CO1: Understand the basics of semiconductors, PN junction diodes, transistors, operational amplifiers with its characteristics.

CO2: Understand different types of Number systems, theorems, postulates of Boolean algebra and logic gates. Apply theorems of Boolean algebra for minimization of Boolean expression. Apply basics of logic gates to draw logic circuits for any Boolean function.

CO3: Apply the basics of diode as rectifiers, clippers, clampers and voltage regulator circuits.

CO4: Analyze DC biasing circuits of BJT, FET and MOSFET's.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO2, PSO3
CO4	PO1,PO2, PO3 /PSO2, PSO3

BECG0800: ELECTRONICS LAB - I

Objective:

- Evaluate the performance of PN junction diode, npn BJT and N-channel EMOSFET.
- Analyze the operations of Rectifiers, clampers and clipper circuits.
- Verify the truth tables of basic gates (NOT, OR, AND) and universal gates (NAND, NOR)

Credits: 01 **L–T–P-J: 0–0-2-0**

Module	List of Experiments:	Lab Hours
I,II & III	1. Identification of various electronics, electrical components and study of measuring instruments and sources used in electronic circuits. (i) Multi-meters (ii) CRO (iii)Function Generator(iv)DC Supply 2. To determine the V-I characteristics of a semi-conductor diode. 3. To study the working of a Half-Wave & Full Wave (Bridge type) rectifier. 4. To study application of diode as clipper circuit and clamper circuit. 5. To study Zener diode as voltage regulator 6. To study V-I characteristic of CE configuration of BJT. 7. To study V-I characteristic of MOSFET. 8. To verify characteristics of op-Amp and realization of Op-Amp as adder &subtract or. 9. To study various logic gates such as OR, AND, NOT, NAND, NOR. 10. Realization of half adder &subtract or using logic gates. 11. Prove the universality of NAND & NOR gate. 12. **Minor project based on experiments performed:** Realization of regulated power supply and its applications.	24

Course outcomes: After completion of this course, student would be able to:

1. Demonstrate the performance of PN junction diode, npn BJT and N-channel EMOSFET and Verify the truth tables of basic gates.
2. Analyze the operations of Rectifiers, clampers and clipper circuits and Op-Amp(IC-741) as adder and subtractor.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO2, PSO3
CO2	PO1,PO2, PO3 /PSO2, PSO3

BECG0801: ELECTRONICS SIMUALTION LAB

Objectives:

- *To become familiar with PSPICE& Xilinx software.*
- *To learn basics of MATLAB software.*
- *Tofamiliar with Lab VIEW software and design small Vis and sub Vs.*

Credits: 01 **L–T–P-J: 0–0-2-0**

Module No.	Content	Teaching Hours
I	**Software Requirement: PSPICE& Xilinx** **List of Experiments** 1. To determine the V-I characteristics of a semi-conductor diode. 2. Synthesis of Half wave and Full wave rectifier. 3. To study the response of *RC*, *RL* and *RLC* circuits 4. Synthesis and simulation of basic logic gates such as OR, AND, NOT, NAND, NOR. 5. Synthesis and simulation of Full Adder. 6. Synthesis and Simulation of Full Subtractor. **Software Requirement: MATLAB** **List of Experiments** 1. To become familiar with MATLAB and Simulink. 2. Present the different ways to execute MATLAB code and techniques for managing loop execution. 3. Present MATLAB code structures to implement decision-making algorithms in your applications. 4. Present a code to build a function and call it in another code. Solve a first order linear differential equation by using MATLAB code.	28

Note: At least 5 experiments from Module I and 5 experiments from Module II must be completed for successful credit evaluation.

COURSE OUTCOMES:*After completion of Lab, student will be able to:*

CO 1:-S*imulate the basic circuits like adder, substractor, logic gates on PSPICE/Xiling*
CO 2:- *learn the basic programming skills for implementing mathematical expression on MATLAB.*

COs	POs/ PSOs
CO1	PO1,PO2, PO3 /PSO2, PSO3
CO2	PO1,PO2, PO3 /PSO2, PSO3

BECG0002: DIGITAL ELECTRONICS

Credits: 04 **L–T–P-J: 3–1–0-0**

Digital Electronics

Course Objectives

- To learn the fundamental concepts of Digital logic design.
- To study methods of logic expression simplification.
- To understand procedure for the analysis of Combinational and Sequential logic circuit.
- To design of Combinational and Sequential logic circuit.

Module No.	Content	Teaching Hours
I	Logic Families, Diode, BJT & MOS as a switching element, concept of transfer characteristics, Input characteristics and output characteristics of logic gates, Fan-in, Fan-out, Noise margin, circuit concept and comparison of various logic families: TTL, CMOS Tri-state logic, open collector output, packing density, power consumption & gate delay. Digital system and binary numbers: Signed binary numbers, binary codes, Cyclic Codes, Error Detecting and Correcting Codes, Hamming Codes. Floating point representation. Gate-level minimization: Five variable K-Map, don't care conditions, POS simplification, NAND and NOR implementation, Quine Mc- Clusky method (Tabular method). Combinational Logic : Combinational circuits, analysis procedure, design procedure, Binary Adder-Subtractor	21
II	Combinational Logic : Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers Synchronous sequential logic: Sequential Circuits, Storage Elements : Latches, Flip Flops, Analysis of Clocked Sequential Circuits, State Reduction and Assignments, Design Procedure Registers and Counters: Shift Registers, Ripple Counter, Synchronous Counter, Other Counters. Memory and programmable logic : RAM, ROM, PLA, PAL, FPGA, PROM, EPROM, EEPROM Asynchronous Sequential Logic : Analysis procedure, circuit with latches, Design procedure, Reduction of state and flow table, Race free state assignment, hazards.	22

Text Book:

1. S. Salivahanan& S. Asivazhagan, "*Digital Circuit & Design*", IInd Edition.

Reference Books:

1. M. Morris Mano and M. D. Ciletti, "*Digital Design*" 4th Edition, Pearson Education.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the basics of number system and different logic families.
2. Implement general problems on combinational and sequential circuits using optimized logic gates.
3. Construct sequential Circuits which includes latches, Flip-Flops, Shift Registers, Ripple Counter, Synchronous Counter, Johnson counter, ring counter and also the analysis of Clocked Sequential Circuits.
4. Analyze the performance of memory devices like RAM, ROM, PROM, EPROM, EEPROM, PLA, and PAL.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECG0802: DIGITAL ELECTRONICS LAB

Objectives:

- Implement the basic of Combinational and sequential circuits and be able to use integrated circuit packages.
- Test a Combinational and sequential circuit using a computer software application.

Credits: 01 **L–T–P-J: 0–0-2-0**

Module No.	Content	Teaching Hours
I	1. Introduction to the lab and testing of logic gate IC's. 2. Realization of Half Adder and Half Subtractor using basic gate and repeat using Nand gate only. 3. Realization of full-adder & full subtractor using logic gates and using Boolean expression. 4. Realization of 4-bit even / odd parity checkers using Ex-OR gate. 5. Realization of 4-bit binary decoder/ demultiplexer. 6. Realization of decimal to BCD encoder using IC 74147. 7. Realization of 4-bit / 3-bit multiplexer. 8. Implementation of RS,JK, T and D flip-flop using logic gates. 9. Realization and implementation serial in parallel out and parallel in serial out shift register. 10. Realization and implementation of 2-bit up/down synchronous counter. 11. Realization and implementation 4-bit binary ripple counter using JK flip-flop. 12. Realization and implementation of Arithmetic logic unit. **Practical on P- SPICE Schematic Software** 13. Realization of full-adder & full subtractor using logic gates using P-SPICE Schematic Software. 14. Realization of 4-bit / 3-bit multiplexer using P- SPICE Schematic Software. 15. Implementation of RS,JK, T and D flip-flop using logic gates using P-SPICE Schematic Software	10

Course Outcomes

After successfully completing the course students will be able to

1. Implement the basic of Combinational and sequential circuits and be able to use integrated circuit packages.
2. Analyze a Combinational and sequential circuit using a computer software application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECC0001: NETWORK ANALYSIS & SYNTHESIS

Course objective:

- To explain the basic concepts and laws of DC and AC electrical networks and solve them using mesh and nodal analysis techniques.
- To learn different network theorem and analyze the electric circuit using network theorem.
- To Introduce Two port network.
- To analyze circuits in time and frequency domain.
- Synthesize the network using passive elements.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**A1: Introduction to Network &circuit :** Review of nodal and mesh analysis, super node and super mesh analysis concept of dependent source (VDVS, VDCS.CDVS$CDCS) and its application **A2: Network Theorems (Applications to ac networks):** AC network theorem :(Super-position , Thevenin's, Norton's, Maximum power transfer , Millman's , Tellegen's & Miller Theorem) **A3: Graph Theory:** Graph of a Network, concept of tree, co-tree, link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix; Duality; Loop and Nodal methods of analysis. **A4: Two Port Networks:** Characterization of LTI two port networks: ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks. T & Π Representation.	21
II	**B1: Transient Analysis:** RL, RC and RLC circuits – classical approach. **B2: Network Functions:** Concept of Complex frequency, Transform Impedances, Network functions of one port and two port networks, properties of driving point immittance and transfer functions. **B3: Network Synthesis:** Positive real function; definition, properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance, functions using Foster and Cauer first and second forms.Concept of Active Synthesis **B4: Filters:** Image parameters and characteristics impedance, low pass, highpass, (constant K type) filters, and introduction to active filters.	21

Text Books:

"

- Charles K. Alexander and Matthew N.O. Sadiku,"5th Ed.Fundamentals of Electric Circuits*Publisher*: McGraw Hill Education.
- D. Roy Choudhary, "*Networks and Systems*" 2nd Ed., New Age International (P) Ltd. Publishers.
- A.Chakrabarti, "*Network Analysis & Synthesis*", Dhanpat Rai & Co.

Reference Books:

- M.E. Van Valkenburg, "*An Introduction to Modern Network Synthesis*", Wiley Eastern Ltd.
- Sudhakar, "*Circuits & Networks: Analysis and Synthesis*", TMH Education Pvt. Ltd.
- K.S. Suresh Kumar, "*Electric Circuits and Networks*" Pearson Education.

COURSE OUTCOMES: Upon completion of this course students will able to:

CO1: Understand the nodal , mesh method , low pass , high pass passive and active filter linear circuit

CO2: Compute two-port network parameters including Z,Y ,h, ABCD for a passive linear network

CO3: Apply the network theorem including thevenin, Norton's, superposition, maximum power transfer, Tellegence, and Millmans for AC and DC linear circuit

CO4: analyze RL, RC, and RLC circuits in time and frequency domains.

CO5 Synthesize the passive network, low pass and high pass passive filter.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO5	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0002: ELECTROMAGNETIC FIELD THEORY

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Review of vector algebra** Scalar & vectors, Unit vectors, Vector addition & subtraction, Position vector, Vector Multiplications, Components of Vector. **Coordinate System & Transformation** Cartesian, cylindrical and Spherical coordinates & their transformation. **Vector Calculus** Line, Surface and Volume Integrals, Gradient of a scalar, Divergence of a Vector, Curl of a Vector, Divergence Theorem, Stokes's Theorem. **Electrostatics-I** Coulomb's law & field intensity, Electric fields due to continuous charge distributions. Electric flux density, Gauss's law, Electric potential. **Electrostatics-II** Electric Dipole, Energy density in electrostatic field, Polarization in dielectrics, Continuity equation and relaxation time, Electric Boundary conditions, Poisson's and Laplace's equation, Capacitance.	21
II	**Magneto statics** Biot-savart's law, Ampere's Circuit law, Magnetic flux density, vector magnetic potential, Maxwell's equations for static field, Forces due to magnetic field, Magnetic torque and moment, Magnetization in materials, Magnetic boundary conditions, Inductance, Magnetic energy. **Maxwell's Equations** Faraday's law, Displacement current, Maxwell's equations in point and integral forms. **E M Wave Propagation** Wave propagation in lossy dielectrics, Plane wave in lossless dielectrics, Plane wave in free space, Plane wave in good conductors, Power and the Poynting vector. **Transmission Lines** Transmission line parameters, Transmission line Equation, Lossless and low loss propagation, Wave reflection and VSWR, transmission line of finite length, Reflection Coefficient, Standing wave ratio, Introduction to Smith Chart, Impedance Matching.	21

Text Book:

- W.H. Hayt and J.A. Buck, "*Electromagnetic Field Theory*", 7th TMH.

Reference Books:

- M.N.O. Sadiku , "*Elements of Electromagnetics*", 4th Ed, Oxford University Press

Course Outcomes:

1. Understand the concepts of electromagnetic field theory.
2. Apply the laws of electromagnetic fields to solve the charge and current distributions.
3. Examine the Laplace's and Poisson's equations.
4. Analyze the electromagnetics to solve the boundary value problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0003: SOLID STATE DEVICES AND CIRCUITS

Credits: 04 **L–T–P-J: 3–1-0-0**

Course Objective:

- To understand the background of intrinsic and extrinsic materials.
- To familiarize the students with characteristics and applications of solid state devices like BJT, MOSFET etc. and study their parameters.
- Analysis of BJT and MOFET amplifiers with parasitic, coupling and bypass capacitors and understand the effect of capacitances in its frequency response.
- To understand and compare the concept of voltage, current, trans-conductance and trans-resistance amplifiers circuits.
- To build various classes of power amplifier circuits using solid state devices.

Module No.	Content	Teaching Hours
I	**EXCESS CARRIERS IN SEMICONDUCTORS.** Optical Absorption. Luminescence. Photoluminescence. Electroluminescence. Carrier Lifetime and Photoconductivity. Direct & Indirect Band gap Semiconductor, Direct & Indirect Recombination, Steady State Carrier Generation, Quasi-Fermi Levels. Photoconductive Devices. Diffusion & Drift of Carriers. The Continuity Equation. Steady State Carrier Injection. **JUNCTIONS.** Equilibrium Conditions. The Contact Potential. Equilibrium Fermi Levels. Space Charge at a Junction. Steady State Conditions. **Type of Junctions** Metal-Semiconductor Junctions. Schottky Barriers. Rectifying Contacts. Ohmic Contacts. Typical Schottky Barriers. Heterojunctions Review of transistors: all configurations of BJTs and FETs with their characteristics. h-parameters; Small signal analysis of Single stage CE BJT amplifier The BJT Internal Capacitance and High Frequency Model ,Frequency Response of the Common-Emitter Amplifier	21
II	Small signal analysis of single stage FET amplifier, Single stage MOS Amplifiers, The MOSFET Internal Capacitance and High Frequency Model **Feedback Amplifiers:** Classification of amplifiers, the feedback concept, The transfer gain with feedback, General characteristics of negative feedback amplifiers, input resistance, output resistance, Method of analysis of feedback amplifier, voltage series feedback, voltage shunt feedback, current series, current shunt feedback. Concept of positive feedback in oscillator. **Output stages and Power amplifiers**: Power amplifiers, Power Transistors, Class A, Class B, Class AB, Class C operation, Design Application. Introduction to Double gate MOSFET(DGMOSFET),FINFET, Spin Transistor.	21

Text Book:

- Ben.G.Streetman&Sanjay Banerjee "*Solid State Electronic Devices*"5th Edition PHI Private Ltd, 2003.
- Sedra S., Smith K., "*Micro-electronics*", 5th edition, OXFORD.

Reference Books:

- Thomas L. Floyd “Electronic Devices” 7th Edition Pearson Education International, 2005
- Jacob Millman, Christos Halkias, SatyabrataJit, “*Electronic Devices and Circuits*”, TMH.

Outcomes: After successful completion of this course, student would be able to:

1. Understand the semiconductor physics of the intrinsic and extrinsic materials; junctions types; Double gate MOSFET, FINFET, Spin Transistor.
2. Describe characteristics of BJT and MOSFET in different configurations and power amplifiers.
3. Analyze the various feedback topologies of a circuit and small signal model of MOSFET.
4. Design a BJT and MOSFET amplifier for the given specifications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1
CO2	PO1,PO2, PO3, PO4 /PSO1
CO3	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0004: SIGNALS AND SYSTEMS

Objective: This course enables the students

- To understand the type and representation of continuous-time and discrete-time signals and systems and sampling theorem.
- To apply convolution integral and convolution sum on the given signals.
- To understand the Fourier series representation of the periodic continuous-time signals
- To analyze the frequency domain response by the means of discrete-time Fourier transform, continuous-time Fourier transform, Laplace transform, and Z-transform.

Prerequisites: Basic knowledge of integration, differentiation, and complex numbers.

Credits: 04 **L–T–P-J: 3–1–0-0**

Module No.	Content	Teaching Hours
I	**Signals:** Definition, types of signals and their representations, commonly used signals (in continuous-time as well as in discrete-time), operations on continuous-time and discrete-time signals (including transformations of independent variables). Systems: Classification, linearity, time-invariance and causality, impulse response, characterization of linear time-invariant (LTI) systems, unit sample response, convolution summation, step response of discrete time systems, stability. convolution integral, co-relations, signal energy and energy spectral density, signal power and power spectral density, properties of power spectral density. **Fourier series** Trigonometric & Exponential Fourier Series Analysis, Sampling Theorem, Nyquist criteria for sampling theorem	13
II	Fourier Transforms (FT): (i) Definition, conditions of existence of FT, properties, magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT, relation between LT and FT (ii) Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT. Laplace-Transform (LT) and Z-transform (ZT): (i) One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC) (ii) One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping Application of Signals and Systems in MATLAB.	13

Text Book:

- P. Ramakrishna Rao, "*Signal and Systems"* 2008 Edn., Tata MGH, New Delhi

Reference Books:

- Chi-Tsong Chen, "*Signals and Systems*", 3rd Edition, Oxford University Press, 2004
- V.Oppenheim, A.S. Willsky and S. Hamid Nawab, "*Signals & System"*, PEARSON Education, Second Edition, 2003.

OUTCOMES: After successful completion of the course, students will be able to:

CO1: Understand sampling, properties of continuous-time and discrete-time signals and systems.
CO2: Compute Fourier series, Fourier transform, Laplace transform, and Z-transform on a given signal.
CO3: Apply continuous-time and discrete-time convolution on the given signals.
CO4: Analyze continuous-time and discrete-time systems in terms of frequency response, magnitude, and phase response.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO3
CO2	PO1,PO2, PO3 /PSO1, PSO3
CO3	PO1,PO2, PO3 /PSO2, PSO3
CO4	PO1,PO2, PO3 /PSO2, PSO3

BECC0005: MICROPROCESSORS AND APPLICATIONS

Credits: 03 **L–T–P-J: 3–0–0-0**

Course Objectives

- To introduce the architectures of 8085 and 8086 Microprocessors.
- To familiarize the students with assembly language programming in 8085 and 8086 Microprocessors.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- To design the interfacing of various peripheral devices with the 8085 Microprocessor.

Module No.	Content	Teaching Hours
I	**Microprocessor and Microprocessor Development Systems:** Evolution of Microprocessor, Microprocessor architecture and its operations, memory, inputs-outputs (I/Os), data transfer schemes interfacing devices, architecture advancements of microprocessors, typical microprocessor development system. **8-bit Microprocessors** **8085 microprocessor:** pin configuration, internal architecture. Timing & Signals: control and status, interrupt: ALU, machine cycles, Instruction Set of 8085, Addressing Modes, Instruction format, op-codes, mnemonics, no. of bytes, RTL, variants, no. of machine cycles and T states **Instruction Classification:** Data transfer, arithmetic operations, logical operations, branching operation, machine control; Writing assembly Language programs, Assembler directives. **16-bit Microprocessors** **8086 microprocessor:** pin configuration, internal architecture. Timing & Signals: control and status, interrupt: ALU, machine cycles.	20
II	Instruction Set of 8086, Addressing Modes, Instruction format, op-codes, mnemonics, no. of bytes, RTL, variants, no. of machine cycles and T states **Interrupts:** Hardware and software interrupts, responses and types. **Peripheral Interfacing:** I/O programming: Programmed I/O, Interrupt Driven I/O, DMA I/O interface: serial and parallel communication, memory I/O mapped I/Os. Peripheral Devices: 8237 DMA controller, 8255- Programmable peripheral interface, 8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller, 8279-keyboard display controller, ADC/DAC interfacing. Introduction to Advanced Microprocessors and Microcontrollers.	20

Text book:

- Gaonkar, Ramesh S, "*Microprocessor Architecture, programming and applications with the 8085*" Pen ram International Publishing 5th Ed.
- Ray, A.K. &Burchandi, K.M., "*Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing*" Tata Mc. Graw Hill.

References books:

5. Uffenbeck, John, "*Microcomputers and Microprocessors*" PHI/ 3rd Edition 5. Brey, Barry B. "*INTEL Microprocessors*" Prentice Hall (India).
6. M. Rafiquzzaman, "*Microprocessors- Theory and applications*" PHI.
7. Ram, "*Advanced Microprocessor & Interfacing*" Tata McGraw Hill.
8. Renu Singh & B.P. Singh, "*Microprocessor and Interfacing and applications*" New Age International.
9. Hall D.V., "*Microprocessors Interfacing*" Tata McGraw Hill.
10. Liu and Gibson G.A., "*Microcomputer Systems: The 8086/8088 Family*" Prentice Hall (India).

Course Outcomes: After successfully completing the course students will be able to:

CO1: Understand the architectures, Memory interfacing and interrupts for 8085 and 8086 Microprocessors.

CO2: Demonstrate assembly language programming using instruction sets of 8085 and 8086 microprocessors.

CO3: Apply the interfacing of various peripherals such as LEDs, 7-segment display, keyboard display controller, and ADC's & DAC's with 8085 microprocessors.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0800: MICROPROCESSOR LAB

Credits: 01 **L–T–P-J: 0–0–2-0**

Course Objectives:

- Introduce Assembly Language Programming (ALP) concepts and features
- Write ALP for arithmetic and logical operations in 8085 and 8086
- Differentiate Serial and Parallel Interface
- Interface different I/Os with 8085 Microprocessor

Module No.	Content	Teaching Hours
I	**List of Experiments using 8085/8086:** **1.** To Study of 8085 Microprocessor Kit. **2.** ToStudy of 8086 Microprocessor Kit. **3.** Write a program to add two 8-bit numbers. **4.** Write a program to add two 16-bit numbers. **5.** Write a program to subtract two 8-bit number. **6.** Write a program to subtract two 16-bit number. **7.** Write a program to multiply two 8 bit numbers by repetitive addition method. **8.** Write a program to divide two 8 bit numbers. **9.** To develop and run a program for finding out the largest from a given set of numbers. **10.** To develop and run a program for finding out the smallest from a given set of numbers. **11.** To develop and run a program for arranging in ascending/descending order of a set of numbers. **12.** To perform computation of square of a given number **13.** Write a program to transfer the block of data from one memory location to other memory location. . **14.** Interfacing with 8255 in I/O mode/BSR mode to 8085/8086 based system. **15.** Interfacing with 8253 to 8085/8086 based system. **Value addition Experiments** **16**. To write an assembly language program to convert an analog signal into a digital signal and a digital signal into an analog signal using an **17**.ADC interfacing and DAC interfacing respectively. To write an assembly language program to simulate the traffic light at an intersection using a traffic light interface.	24

Course Outcomes: After successfully completing the course students will be able to:

1. Implement the assembly language program for arithmetic and logical operation on microprocessor kit.
2. Demonstrate the interfacing among the peripherals of 8085 and 8086.
3. Interface LED, ADC and DAC modules with microprocessor based system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO3	PO1,PO2, PO3 /PSO2, PSO3

BECC0006: ANALOG INTEGRATED CIRCUITS

Credits: 03 **L–T–P-J: 3–0–0-0**

Objectives:

- Understand the internal circuit of op-amp and design linear and non-linear circuits.
- Design of simple current mirror, Wilson and improved Wilson current mirrors, Widlar current and cascade current mirror circuits.
- Design filters (first and second order LP, HP, BP and all pass active filters, state variable filter, switched capacitor filters circuits) using op-amp.

Module No.	Content	Teaching Hours
I	**Differential amplifier**: differential amplifier as a building block for operational amplifier; differential amplifier configuration, AC-DC Characteristics, **Circuit Mirror Circuits:** Current Mirrors using BJT and MOSFETs, Simple current Mirror, Base Current compensated current Mirror, Wilson and Improved Wilson Current Mirrors, Widlar Current source and Cascade current Mirror. **Operational Amplifier :**Basic Information of Op-Amp, The ideal Operational Amplifier, Operational Amplifier Internal Circuit, DC and AC Characteristics **Linear Applications of Op-Amp:** V to I and I to V converter, Differentiator, Integrator, Instrumentation Amplifier. **Active Filters :** First and Second order LP, HP, BP, BS and All pass active Filters, State Variable Filter, Switched Capacitor Filters. **Non-Linear Applications:** Op-Amp Circuits using diodes, Sample and Hold Circuit, Log and Antilog Amplifier, Multiplier and Divider.	21
II	**Comparators and Waveform Generators:** Regenerative Comparator (Schmitt Trigger), Square Wave Generator (Astable Multi vibrator), Mono stable Multi vibrator, Triangular Wave Generator, Basic Principle of Sine Wave Oscillators. **Voltage Regulator:** Series Op-Amp Regulator, IC Voltage Regulators, 723 General Purpose Regulators, Switching Regulator. **555 Timer :** Description of Functional Diagram, Mono stable Operation, Astable Operation, Schmitt Trigger **Phase-Locked Loop** : Basic Principles, Phase Detector/Comparator, Voltage Controlled Oscillator (VCO), Low Pass Filter, Monolithic Phase-Locked Loop, PLL Applications **D-A and A-D Converters :**Basic DAC Techniques, A-D Converters, DAC/ADC Specifications **Introduction to OTA**	21

Text Book:

- Roy Choudhury, Shail B. Jain "*Linear Integrated Circuits*", 4th Edition, New Age International Publishers.

Reference Books:

- Ramakant A. Gayakwad, "*Op-Amps & Linear Integrated Circuits*", 3rdEdition, PHI.
- Sedra and Smith, "*Microelectronics Circuits*" 4th Edition, Oxford University Press.
- Michal Jacob, "*Applications and Design with Analog Integrated Circuits"*, 2nd Edition, PHI 2006
- Jacob Milliman and Arvin Grabel, "*Microelectronics*", 2nd Edition, TMH, 2008.

Course Outcomes: After successfully completing the course students will be able to:

CO 1:- Understand the basics of op-amp, topologies of current mirrors and the working of PLL.
CO 2:- Apply the IC 555 timer to design stable and mono-stable multi-vibrator.
CO 3:- Design filters (first and second order LP, HP, BP and all pass active filters, state variable filter, switched capacitor filters circuits) using op-amp.
CO 4:- Analyze the performance of oscillators and waveform generators including Schmitt trigger, triangular wave generator, sine wave generators, A/D and D/A converters for signal processing applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2

BECC0801: ELECTRONICS LAB – II

Credits: 01 **L–T–P-J: 0–0-2-0**

Course Objectives: The main aim of this lab is to teach the linear and non-linear applications of operational amplifiers (741). Students are made familiar with theory and applications of 555 timers. Students are made to Design analog circuits using ICs.

Module No.	Content	Teaching Hours
I	**List of Experiments** 1. Realization of JFET as amplifier and determine various parameters. 2. Realization of tuned amplifier and its application in Hartley and Collpit oscillator. 3. Realization of Wien Bridge oscillator and crystal oscillator. 4. A. Realization of MOSFET as a switch. B. Transient analysis of CMOSinverter using step and pulse input using P-SPICE Schematic Software. 5. A. Realization of BJT as a buffer amplifier. B. Plot the voltage transfer characteristics of BJT inverter and perform transient analysis with step and pulse input using P-SPICE Schematic Software. 6. A. Realization of multistage amplifier using BJT and calculation of current gain B. Draw the input and output characteristic of BJT transistor in common-emitter configuration using P-SPICE Schematic Software. 7. Realization of comparator and zero crossing detector-using op- Amp. 8. A. Realization of second order active low pass and high pass filter. B. Design and simulation of 2nd order Active Low Pass and High Pass Filter. 9. Realization of Astable and Mono stable multi vibrator using IC 555. 10. Realization of voltage controlled oscillator using IC 8038/2206 & 723. 11. Realization of V to I and I to V convertor. 12. To study PLL and analyze the locking and capturing frequency range	24

Course Outcomes: After successfully completing the course students will be able to:

CO 1 Implement the amplifying characteristics of BJT and JFET as well as transient analysis of CMOS and MOSFET as a switch and the different types of oscillators and multi vibrators circuits, comparator, V to I and I to V convertors, 2nd order filters using op-amp..

CO 2 Simulate analog circuits on p-spice environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2, PSO3

BECC0007: CONTROL SYSTEMS

Credits: 04 **L–T–P-J: 3–1–0-0**

Control System

Course Objectives:

- To learn the fundamental concepts of Control systems and mathematical modeling of the system
- To study the concept of time response and frequency response of the system
- To learn the basics of stability analysis of the system
- To study state space representation of the system.

Module No.	Content	Teaching Hours
I	**Introduction to control system:** Industrial control examples, Transfer function models of mechanical, Various electrical systems: Synchros, DC and AC servomotors, tacho-generators, potentiometers. **Open and closed-loop systems**: Block diagram representation and reduction, Signal flow graph analysis. **State-space model:** State variable, State models for LTI systems, Diagonalization. **Time domain analysis:** Time responses of first and second order LTI systems, Test signals, Time-domain specifications and performance indices.	21
II	**Stability analysis:** Stability concept, Relative stability, Hurwitz and Routh stability criterion, Root locus technique. **PID controller:** Design, tuning and applications **Frequency domain analysis:** Correlation between time & frequency responses, Performance specifications in frequency-domain. Polar plot, Bode plot, Stability in frequency domain, Nyquist plot and stability criterion, Lead and Lag compensators, Frequency-domain design methods.	21

Text book:

1. J. Nagrath& M. Gopal, "Control System Engineering", New Age International Publishers

References books:

2. B.C. Kuo&FaridGolnaraghi, "Automatic Control Systems", 8th Edition, John Wiley India.
3. William A. Wolovich, "Automatic Control Systems", Oxford University Press.
4. Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Control Systems" Schaums Outlines Series, 3rdEdition, Tata McGraw Hill, Special Indian Edition .

Course Outcomes:

After successfully completing the course students will be able to:

1. Understand the basic steps of mathematical model of a mechanical, electrical system and their analogy and block-diagram reduction technique and SFG to obtain transfer function of system.
2. Compute the time response and frequency response specifications of 1^{st} and 2^{nd} order systems.
3. Analyze the stability of the system using RH criterion, Nyquist criterion, root locus and Bode plots.
4. Design the P, D, I, PD, PI and PID controllers and Lag, Lead and Lead-Lag compensators.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO2, PSO3
CO4	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0802: CONTROL SYSTEM LAB

Credits: 01 **L–T–P-J: 0–0–2-0**

Objective:

- To perform the experiment related to the different controlling component.
- To analyze transient and steady state response of the overall system.
- To simulate transient response of control system in Matlab environment

<table>
<tr><th>Module No.</th><th>Content</th><th>Teaching Hours</th></tr>
<tr><td>I</td><td>List of Experiments
1. DC SPEED CONTROL SYSTEM
(a) To study D.C. speed control system on open loop and close loop.
(b) To study of Transient performance, another time signal is added at the input of control Circuit.
2. DC MOTOR POSITION CONTROL
(a) To study of potentiometer displacement constant on D.C. motor position control.
(b) To study of D. C. position control through continuous command.
(c) To study of D.C. position control through step command.
(d) To study of D.C. position control through Dynamic response.
3. AC SERVOMOTOR
(a) To study speed-torque characteristic of an AC Servomotor.
4. SYNCHRO TRANSMITTER / RECEIVER
(a) To study of Synchro Transmitter in term of Position v/s Phase and voltage magnitude with respect to Rotor Voltage Magnitude/Phase.
(b) To study of remote position indication system using Synchro-transmitter/receiver.
5. PID CONTROLLER
(a) To observe open loop performance of building block and calibration of PID Controls.
(b) To study P, PI and PID controller with type 0 system with delay.
(c) To study P, PI and PID controller with type 1 system.
6. LEAD LAG COMPENSATOR
(a) To study the open loop response on compensator.
(b) Close loop transient response.
7. LINEAR SYSTEM SIMULATOR
(a) Open loop response (i) Time constant, (iii) Integrator
(b) Close loop system (I) First order system (II) Second order system
8. Introduction to MATLAB (Control System Toolbox), Implement at least two experiments in MATLAB.
(a) Determine transpose, inverse values of given matrix.
(b) Plot the pole-zero configuration in s-plane for the given transfer function.
(c) Determine the transfer function for given closed loop system in block diagram representation.</td><td>24</td></tr>
</table>

		(d) Plot unit step response of given transfer function and find peak overshoot, peak time. (e) Plot unit step response and to find rise time and delay time. (f) Plot locus of given transfer function, locate closed loop poles for different values of k. (g) Plot root locus of given transfer function and to find out S, Wd, WN at given root & to discuss stability. (h) Plot bode plot of given transfer function. (i) Plot bode plot of given transfer function and find gain and phase margins. (j) Plot Nyquist plot for given transfer function and to compare their relative stability. (k) Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.	

Outcomes: After successful completion of this course, student are able to

CO 1: Implement the input/output relation of different control element as potentiometer, dc motor, synchro and servo motor and their transient behavior.

CO 2: Simulate control algorithms Root Locus, Bode plots, Nyquist plots, Lead, Lag and Lead-Lag compensator, PID controllers on MTLAB environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO2, PSO3

BECC0008: COMMUNICATION ENGINEERING

Credits: 04 **L–T–P-J: 3–1–0-0**

Course Objectives:

- To understand the elements of electronic communication system and the need for modulation, their application and specification.
- To understand the process of amplitude and angle modulation and demodulation; calculate its modulation index, power & bandwidth; sampling and quantization; and compare the continuous, pulse and digital modulation schemes.
- To comparison between the variants of AM and Pulse modulation techniques; including DSB-SC, SSB-SC and VSB Modulation, PAM, PWM, PPM and PCM
- To design the modulator and demodulator for amplitude modulator including balance, ring, square law, phase shift and filtering method; frequency modulator including direct and indirect method; amplitude demodulation including coherent and non-coherent method; angle demodulation including frequency and phase discriminator
- To classify the sources of noise and evaluate the performance of demodulators in presence of AWGN.

Module No.	Content	Teaching Hours
I	**Amplitude – Modulation** Frequency translation, amplitude modulation, double side band – suppressed carrier (DSB-SC) modulation, double side band with carrier (DSB-C), single-sideband modulation (SSB), vestigial-sideband modulation. **Angle -Modulation** Angle modulation, phase and frequency modulation; tone modulated FM signal, arbitrary modulated FM signal, FM modulators and demodulators, radio transmitter and receiver. **Noise in Communication Systems** Sources of noise, frequency-domain representation of noise, superposition of noises, linear filtering of noise, quadrature components of noise, representation of noise using orthonormal coordinates	21
II	**Noise Analysis of Communications system** single-sideband suppressed carrier, double-sideband suppressed carrier, double sideband with carrier, FM receiving system, calculation of signal to noise ratio, comparison of FM and AM, reemphasis and de-emphasis, noise in phase modulation, threshold in frequency modulation. **Pulse Modulation and Digital Transmission of Analog Signal** Analog to digital: noisy channel and role of repeater, pulse amplitude modulation and concept of time division multiplexing, pulse width modulation and pulse position modulation, digital representation of analog signal, differential pulse code modulation and delta modulation, noise in PCM transmission, noise in delta modulation transmission.	22

Textbook:

Herbert Taub, Donald L Schilling, GoutamSaha “*Principles of Communication Systems*” Third. Edition.TMH

Reference Books:

- B.P.Lathi and Zhi Ding “*Modern Digital and Analog Communication Systems*” fourth edition, Oxford University Press.
- S. Haykins “*Communication Systems*” 5th ed. John wiley.

Course Outcomes: After successful completion of the course students will be able to

1. Understand the elements of electronic communication system and the need for modulation, their application and specification, the process of amplitude and angle modulation, sampling, quantization and pulse modulation.
2. Classify the DSB-SC, SSB-SC and VSB Modulation Techniques, Narrowband FM and Wideband FM, sources of noise.
3. Analyze the performance of demodulators in presence of AWGN.
4. Design the modulator and demodulator circuits for continuous wave and pulse modulation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3,PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3,PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0803: COMMUNICATIONENGINEERING LAB

Credits: 01 **L–T–P-J: 0–0–2-0**

- Implement the Amplitude modulation and demodulation techniques including AM, DSB-SC, SSB-SC
- Implement the Frequency demodulation and demodulation techniques including Direct and

Module No.	Content	Teaching Hours
I	**List of Experiments** • Realization of amplitude modulation using transistors and determine its modulation Index. • Realization of envelope detector for demodulation of AM wave and observe diagonal peak clipping effect. • Realization of frequency modulation & demodulation. Find its modulation index. • Realization of DSB-SC modulation and demodulation. • Realization of SSB modulation and demodulation. • Realization of pulse amplitude modulation and demodulation. • Realization of pulse width modulation and demodulation. • Measurement of characteristic impedance of transmission line. • Plot the radiation pattern of Yagi-Uda antenna and find its beam width. • Measurement of selectivity, sensitivity and fidelity of super heterodyne receiver.	24

Course Outcomes: After successful completion of the course students will be able to

1. Implement the Amplitude modulation and demodulation techniques including AM, DSB-SC, SSB-SC, Frequency demodulation and demodulation techniques including Direct and Indirect generation method; Frequency discriminator and phase discriminator.
2. Demonstrate signals for PAM and PWM and their detection.
3. Draw radiation pattern of Yagi Uda antenna and calculate beam width.

R Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO2	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0009: DIGITAL COMMUNICATION

Credits: 04 **L–T–P-J: 3–1–0-0**

Course Objectives:

- To understand the different basic blocks of digital communication system.
- To design mathematical model of communication channels and digital signals.
- To analyze the signal flow in a digital communication system.
- To analyze the performance of digital communication in the presence of noise and interference.
- To understand the basic concept of information theory and different coding techniques

Module No.	Contents	Teaching Hours
I	**Introduction:** Digital communication system (description of different modules of the block diagram), Complex baseband representation of signals, Gram-Schmidt orthogonalization procedure, bi-orthogonal signals, simplex signal waveforms. Pulse shape design for channels with ISI: Nyquist pulse, Partial response signaling (duobinary and modified duobinary pulses). **Stochastic model of signal**: Power spectral density of random signal, Multiple random processes. Transmission through LTI system, Gaussian and white process, bandpass process. **Modulation:** Pulse amplitude modulation (binary and M-ary, QAM), Pulse position modulation (binary and M-ary), Carrier modulation (M-ary ASK, PSK, FSK, DPSK), Continuous phase modulation (QPSK and variants, MSK, GMSK).	21
II	**Receiver in additive white Gaussian noise channels:** Coherent and noncoherent demodulation: Matched filter, Correlator demodulator, square-law, and envelope detector, Bit-error-rate, symbol error rate for coherent and noncoherent schemes. **Information Theory and Coding:** Measure of information, Source encoding, Error free communication over a noisy channel, Channel capacity of discrete and continuous memory less channel **Error Correcting codes**: Hamming sphere, Hamming distance and Hamming bound, Relation between minimum distance and error detecting and correcting capability, Linear block codes, Encoding & syndrome decoding, Cyclic codes, Systematic cycle codes, convolution codes, code tree & Trellis diagram, Viterbi and sequential decoding, burst error correction, Turbo codes.	21

Text Books:

- B.P. Lathi&Zhi Ding, "*Modern Digital and Analog Communication System*", 4theditin, Oxford University Press, 2010.

Reference Books:

- J. G. Proakis and M. Salehi, "*Fundamentals of Communication Systems*", Pearson Education, 2005.
- S. Haykins, "*Communication Systems*", 5th ed., John wiley, 2008.
- M. K. Simon, S. M. Hinedi and W. C. Lindsey, "*Digital Communication Techniques*": Signaling and detection, Prentice Hall India, N. Delhi, 1995.

Course Outcomes: After successful completion of the course students will be able to

1. Understand the functions of basic blocks in digital communication and basic error correcting coding and decoding techniques.
2. Represent the digital signal in baseband, pass-band format and vector space.
3. Apply the digital modulation schemes ASK, PSK, FSK, QPSK.
4. Analyze the performance of digital communication in presence of AWG noise.
5. Design the optimum receivers for digital communication.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3,PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3,PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO5	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0804: DIGITAL COMMUNICATION LAB

Credits: 01 **L–T–P-J: 0–0–2-0**

1. Implement the basic modulation and demodulation techniques in Lab Kit.
2. Write Matlab program to analyze the performance of different modulation schemes

Module No.	Content	Teaching Hours
I	**List of Experiments** • To study and realization of sample & hold circuit. • To study and realization of delta modulator and demodulator. • To study and realization of pulse code modulator and demodulator. • To study coding and decoding of NRZ-L, NRZ-M data format. • To study coding and decoding of AMI, Manchester data format. • To study and realization of ASK modulator and demodulator. • To study and realization of FSK modulator and demodulator. • To study and realization of PSK modulator and demodulator. • To study and realization of hamming error detection and correction codes. • Simulation of digital communication transmitter. • Simulation of digital communication receiver. **Value addition experiments** • To study and realization of QPSK modulator and demodulator. • To study GSM Mobile trainer & observe Transmitted/Received RF Signal.	24

Course Outcomes: After successful completion of the course students will be able to

1. Implement the basic modulation and demodulation techniques in Lab Kit.
2. Write MatLab program to analyze the performance of different modulation schemes

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO2	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0010: DIGITAL SIGNAL PROCESSING

Credits: 04 **L–T–P-J: 3–1–0-0**

- To understand the discrete signals and system.
- To apply the theory of digital signal processing theory to design digital filters.

Module No.	Contents	Teaching Hours
I	IIR Filters: Definition, IIR Filter design by Approximation of Derivatives, Impulse Invariance & Bilinear Transformation. Characteristics of Commonly Used Analog Filters. Application of above techniques in the design of Butterworth &Chebyshev Filters.	21
II	FIR Filters: Definition, Symmetric and Anti-symmetric FIR Filters, Design of Linear-Phase FIR Filters Using Windowing technique & Frequency Sampling Method. Basic IIR Filter Structures: Direct forms (I & II), cascade and parallel Structures, signal flow graph, transposed structure. Basic FIR filter Structures: Direct form structure, frequency sampling Structure, Ladder Structure. Linear phase FIR structure.	21

Text Book:

- John G. Prokias, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education, Fourth Edition
- S Salivahanan, A Vallavaraj, C Ganapriya, "Digital Signal Processing", TMH, Second Edition

Reference Book:

- Alan V.Oppenheim, Ronald W.Schafer, John R. Buck "Discrete Time Signal Processing" PHI, Second Edition

Course Outcomes: After successful completion of the course students will be able to

CO 1: Understand the digital signal and discrete time signal representation in different domain.
CO 2: Apply the filter design algorithm to design IIR and FIR filters.
CO 3: Characterize finite Word length effect on filters.
CO 4: Analyze the performance of equalizers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3,PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3,PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3,PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0805: DIGITAL SIGNAL PROCESSING LAB

Objective: This course enables the students

- To recall DFT, inverse DFT, DFT properties, and FFT algorithms.
- To experiment with DSP Starter Kit (DSP) and familiar with Code Composer (CC) Studio software.
- To apply DFT, FFT, and circular convolution on DSK.
- To analyze IIR and FIR filters outputs with the help of codecs and CRO.

Prerequisites: Signals & Systems and Digital Signal Processing (DSP)

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I	1. To study TMS320C6713 Digital Signal Processing Kit (DSK). 2. To show sampling and waveform generation using TMS320C6713 Digital Signal Processing (DSK). 3. To compute DFT of any particular sequence using TMS320C6713 Digital Signal Processing (DSK). 4. To compute FFT using TMS320C6713 Digital Signal Processing Kit (DSK). 5. To implement DSP processor using TMS320C6713 Digital Signal Processing Kit (DSK). 6. To study various Digital Modulation Schemes using TMS320C6713 Digital Signal Processing(DSK). 7. To Design FIR filter using TMS320C6713 Digital Signal Processing Kit (DSK). 8. To Design IIR filter using TMS320C6713 Digital Signal Processing Kit (DSK) **VALUE ADDITION EXPERIMENTS** 1. To Design Low pass digital butterworth IIR Filter using Bilinear Transformation method that satisfies the following constraints through MATLAB. $0.9 \leq \lvert H(e^{j\omega}) \rvert \leq 1, \quad 0 \leq \omega \leq \pi/2$ $\lvert H(e^{j\omega}) \rvert \leq 0.2, \quad 3\pi/4 \leq \omega \leq \pi$ 2. To Design High pass butterworth FIR Filter (w_c=π/4) using Rectangular Window function (N=5).	32

Course Outcomes: After successful completion of the course students will be able to

CO1: Implement sine waveform, DFT, FFT, linear convolution, circular convolution, ASK, PSK, and FSK through Code Composer Studio on DSP starter kit.

CO2: Analyze the output of low-pass, high-pass, band-pass, and band-stop IIR and FIR Butterworth filters.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3,PO4 /PSO1, PSO3
CO2	PO1,PO2, PO3,PO4 /PSO2, PSO3

BECC0011: VLSI DESIGN

Credits: 03 L–T–P-J: 3–0–0-0

Course Objectives

- To understand the fundamental concepts of VLSI design methodologies and the fabrication process of an IC.
- To learn the modeling of MOS transistor and CMOS technology.
- To implement the digital circuits using state of art technologies to achieve a highly efficient performance in terms of area, speed and power dissipation.

Module No.	Contents	Teaching Hours
I	**Introduction:** Overview of VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality. **MOSFET Fabrication:** Fabrication process flow, NMOS and CMOS Fabrication .Layout design rules stick diagram and mask layout design. **MOS Transistor :** MOS Structure, Operation of MOSFET, MOSFET - Current /Voltage Characteristics, Scaling and Small geometry effects and capacitances. **MOS Inverters:** Introduction, Resistive Load Inverter, Inverters with n-type MOSFET load-Depletion load inverter, Enhancement load, CMOS Inverter **MOS Inverters** - Switching Characteristics: Introduction, Delay – Time Definitions, Calculation of Delay Times	21
II	**Combinational MOS Logic Circuits**: Introduction, MOS logic circuits with depletion NMOS Loads, CMOS logic circuits, complex logic circuits, CMOS transmission gates. **Sequential MOS Logic Circuits:** Introduction, behavior bistable elements, SR latch circuits, clocked latch and FF circuits, CMOS D latch and edge triggered FF. **Dynamic logic circuits:** Introduction, basic principle of pass transistor circuits, synchronous dynamic circuit techniques, dynamic CMOS circuit techniques, Domino CMOS logic. **Low Power CMOS Logic Circuits:** Introduction, Overview of Power Consumption, Low – Power Design through voltage scaling, Estimation and Optimization of switching activity	20

Text Books:

- Sung-Mo Kang &YosufLeblebici, "*CMOS Digital Integrated Circuits: Analysis & Design*", TMH, 3rd Edition.

Reference Books:

- A. Pucknell and K. Eshraghian, "*Basic VLSI Design: Systems and Circuits*", PHI, 3rd Ed., 1994.
- S.M.Sze, "*VLSI Technology*", Tata McGraw-Hill, Second Edition -2003.

Course Outcomes

After successfully completing the course students will be able to

1. understand the design steps to make the layout of a VLSI circuit with the help of Y-chart and the fabrication process of a CMOS transistor using n-well technology.
2. Illustrate the modeling of a MOS transistor and the effect of scaling on its characteristics.
3. Calculate the noise margin, propagation delay and the transient delay of the CMOS circuits and various gates implemented by the CMOS technology.
4. Design the efficient IC of various combinational and sequential circuits using CMOS technology and other state of art technologies like CMOS transmission gate etc.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3,PO4 /PSO1, PSO2, PSO3

BECC0806: CAD OF ELECTRONICS LAB

Credits: 01 **L–T–P-J: 0–0–2-0-0**

Objective:

- To describe and verify each step of VLSI design flow to design a digital circuit.
- To synthesize and simulate the various combinational and sequential circuits through different modeling of the VHDL.

Module No.	Content	Teaching Hours
I	**Software Requirement: Xilinx (VHDL)** **List of Experiments** 1. Synthesis and simulation of Full Adder. 2. Synthesis and Simulation of Full Subtractor. 3. Synthesis and Simulation of 3 X 8 Decoder. 4. Synthesis and Simulation of 8 X 1 Multiplexer. 5. Synthesis and simulation of priority encoder. 6. Synthesis and simulation of 2bit comparator. 7. Synthesis and Simulation of 9 bit odd parity generator. 8. Synthesis and Simulation of Flip Flop (D, and T). 9. Synthesis and simulation of MOD 10 counter. 10. Synthesis and simulation of Johnson counter. **Tool to be Used: Tanner EDA Using TSPICE** 1. Draw the forward and reverse bias characteristic curves of PN Junction diode. 2. A. Transient analysis of CMOS inverter using step and pulse input. B. DC analysis (voltage transfer characteristics) of CMOS inverter. 3. A. Transient & DC Analysis of CMOS-NOR Gate. B. Transient& DC Analysis of CMOS-NAND Gate. 4 . Perform DC and Transient Analysis for CMOS Implementation of SR Latch. 5. Perform DC and Transient Analysis for 1 Bit CMOS Full Adder. 6. Perform DC and Transient Analysis for 8T TSPC D Flip Flop	28

Note:At least 6 Experiments from Module I and 4 Experiments from Module II must be completed for successful credit evaluation.

Course Outcomes: After successfully completing the course students will be able to:

1. Synthesize and simulate the various combinational and sequential circuits through different modeling of the VHDL
2. Analyze the DC and transient characteristics of the CMOS digital circuit using Tanner tool.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific

Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3

BECC0012: ADVANCED MICROPROCESSORS

Credits: 03 **L–T–P-J: 3–0–0-0**

COURSE OBJECTIVES:

- To impart basic understanding of the internal organization of 8085,8086 and advancedRISC and CISC Microprocessor
- To introduce the concepts of interfacing microprocessors with external devices.
- To develop Assembly language programming skills.

Module No.	Content	Teaching Hours
I	**Microprocessor and Microprocessor Development Systems:** Evolution of Microprocessor, Microprocessor architecture and its operations, memory, inputs-outputs (I/Os), data transfer schemes interfacing devices, architecture advancements of microprocessors, typical microprocessor development system. **8-bit Microprocessors** **8085 microprocessor:** pin configuration, internal architecture. Timing & Signals: control and status, interrupt: ALU, machine cycles, Instruction Set of 8085, Addressing Modes, Instruction format, op-codes, mnemonics, no. of bytes, RTL, variants, no. of machine cycles and T states **Instruction Classification:** Data transfer, arithmetic operations, logical operations, branching operation, machine control; Writing assembly Language programs, Assembler directives. **8086 microprocessor:** pin configuration, internal architecture. Timing & Signals: control and status, interrupt: ALU, machine cycles, Instruction Set of 8086.	20
II	**Introduction to Pentium Microprocessor** – Special Pentium registers-Pentium memory management ,New Pentium Instructions,Pentium Processor ,Special Pentium pro features , Pentium 4 processor **Peripheral Interfacing:** I/O programming: Programmed I/O, Interrupt Driven I/O, DMA I/O interface, memory I/O mapped I/Os. Peripheral Devices: 8237 DMA controller, 8255-Programmable peripheral interface, 8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller **The RISC revolution** – Characteristics of RISC Architecture, RISC architecture and pipelining, The ARM processors ,ARM registers, ARM instructions	20

Text Books:

- Gaonkar, Ramesh S, "*Microprocessor Architecture, programming and applications with the 8085*" Pen ram International Publishing 5th Ed.
- Ray, A.K. &Burchandi, K.M., "*Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing*" Tata Mc. Graw Hill.
- Barry B.Brey, The Intel Microprocessors 8086/8088, 80, 86, 80286, 80386 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and interfacing, Prentice Hall of India Private Limited, New Delhi, 2003
- John Peatman, Design with Microcontroller McGraw Hill Publishing Co Ltd, New Delhi.

Reference Books:

- Uffenbeck, John, "*Microcomputers and Microprocessors*" PHI/ 3rd Edition 5. Brey, Barry B. "*INTEL Microprocessors*" Prentice Hall (India).
- M. Rafiquzzaman, "*Microprocessors- Theory and applications*" PHI.
- Ram, "*Advanced Microprocessor & Interfacing*" Tata McGraw Hill.
- Renu Singh &B.P. Singh, "*Microprocessor and Interfacing and applications*" New Age International.
- Hall D.V., "*Microprocessors Interfacing*" Tata McGraw Hill.
- Liu and Gibson G.A., "*Microcomputer Systems: The 8086/8088 Family*" Prentice Hall (India).

COURSE OUTCOMES: After successful completion of this course students able to

CO1: Understand the architecture, addressing modes, and instructions of 8085 ,8086 and ARM microprocessor.

CO2:: Develop assembly language programs using software interrupts, subroutines, macros .

CO3: Analyze the features of RISC and CISC Processor.

CO4: Design memory, I/O devises interface with 8085 and 8086 microprocessors.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3,PO4 /PSO1, PSO2, PSO3

BECE0070: SIMUALTION LAB-II

Credits: 01 **L–T–P-J:0–0-2-0**

Objective:

- Describe the program structure of LabVIEW and cadence software.
- Implementation of programming in LabVIEW as well as cadence for basic control system problems and circuit analysis, respectively.

Module No.	Content	Teaching Hours
I	**ListofExperiments ofLabVIEW Academy** □ Basics ofLabVIEW and tolearn differentMatrix operations. □ Plottheresponse ofa firstordersystemusingunitstep input. □ Tolearn aboutthe datainputandoutputfeature ofmyRIO. **Experiments based Cadence Virtuoso** □ Study of MOS Device Characterization using cadence virtuoso tool □ implementation of Inverting Amplifiers □ Design simulation of simple Current Mirrors using cadence virtuoso	16

COURSE OUTCOMES: After successfully completing the course students will be able to:

CO1: Describe the program structure of LabVIEW and cadence software.
CO2: Implementation of programming in LabVIEWas well as cadence for basic control system problems and circuit analysis, respectively.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO2, PSO3

BECE0001: RANDOM VARIABLES & STOCHASTIC PROCESSES

Objectives:

- To understand the concepts of basic probability and random variables.
- To familiarize some standard distributions function and their properties.
- To understand the concepts of random process, properties.
- To apply the knowledge of random processes in communication signal.

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	PROBABILITY: Introduction of Probability through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, Independent Events. THE RANDOM VARIABLE: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete and Continuous, Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Methods of defining Conditioning Event, Conditional Density, Properties. OPERATION ON ONE RANDOM VARIABLE: Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skewness, Chebychev's Inequality, Characteristic Function, Moment Generating Function.	22
II	MULTIPLE RANDOM VARIABLES: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, (Proof not expected). Expected Value of a Function of Random Variables: Joint Moments about the Origin, Joint Central Moments. RANDOM PROCESSES: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. Stationary Processes, Wide-Sense Stationarity, Strict-Sense Stationarity, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process. The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function. Random process on LTI System. Arbitrary Noise Sources, Effective Noise Temperature, Average Noise Figures, Average Noise Figure of cascaded networks.	21

Text Book:

1. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, TMH, 4th Edition.
2. Probability, Random Variables and Stochastic Processes – Athanasios Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition.

Reference Books:

1. Communication Systems Analog & Digital – R.P. Singh and S.D. Sapre, TMH.
2. Probability and Random Processes with Application to Signal Processing – Henry Stark and John W. Woods, Pearson Education, 3rd Edition.
3. Probability Methods of Signal and System Analysis. George R. Cooper, Clave D. MC Gillem, Oxford, 3rd Edition.
4. Statistical Theory of Communication - S.P. Eugene Xavier, New Age Publications.

Web materials: video lecture by Prof Mrinjunjay Chakraborthy, IIT, Kharagpur

Outcomes: After the successful completion of this course, students should able to

CO1: Understand the basic probability theory and modeling of random variable from random experiment.
CO2: Demonstrate statistical distributions of one and two dimensional random variables and correlations
CO3: Compute the statistical properties parameters of given random variables and processes.
CO4: Apply different statistical theorem like Bay's, CLT, Chebycheff's inequality theorem to model the communication system.
CO5: Analyze the power and energy spectral density function and spectrum estimation stochastic signals.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO1, PSO2
CO4	PO1,PO2, PO3 /PSO1, PSO2
CO5	PO1,PO2, PO3 /PSO1, PSO2

BECE0002: ANTENNA ANDWAVE PROPAGATION

Credits: 03 **L–T–P: 3–0–0**

Course Objectives:

- To understand the fundamental parameters of antenna.
- To design different types of wire, aperture, Patch, reflector, Broadband and
- Frequency Independent antennas.
- To analyze the different types of arrays and their radiation pattern.
- To describe the measurement techniques of various antenna parameters.
- To understand the basic concept of wave propagation and different wave propagation methods

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Antenna parameters: Patterns, Beam Area (Beam solid angle), Radiation Intensity, Beam efficiency, Directivity & Gain, Directivity & Resolution, Antenna Apertures, Effective height, Radio Communication link , Retarded Potential, Power Radiation by small Current element. **Antenna Arrays**: Introduction. Arrays of two isotropic point sources, Non isotropic but similar point sources, Principle of pattern multiplication, Linear arrays of n isotropic point sources of equal amplitude and spacing, Linear broadside arrays with non-uniform Amplitude distributions: General consideration, Example of Dolph-Tchebyscheff(D-T) distribution for an array of eight sources. **Practical antennas I:** Horizontal Antennas above plane ground, Vertical Antenna above plane ground, Folded dipole antenna, Yagi-Uda antenna, The small loop, comparison of Far fields of small loop and short dipole, Radiation resistance of loops, slot antenna, Babinet's principle of complementary antennas, Impedance of slot antenna.	24
II	**Practical antennas II**: Patch or micro-strip antennas, Designing of MSA, Horn Antennas, the rectangular Horn antenna, Helical Antenna, Reflector antennas: Flat sheet reflector, corner reflector and design, Paraboloid Reflector, Comparison between parabolic and corner reflector, Broadband and frequency independent antenna: Basics, log periodic Antenna. **Antenna Measurements**: Gain, Directional pattern, Phase, polarization **Wave propagation:** Electromagnetic or radio waves, modes of propagation, Structure of atmosphere, Ground waves or surface wave propagation, Ground wave attenuation factor A, Sky wave or ionosphere wave propagation, space wave propagation , Propagation of radio waves through ionosphere or expression for the refractive index of the ionosphere, Mechanism of radio waves bending by the ionosphere, critical frequency, virtual height, maximum usable frequency, calculation of MUF, LUF, skip distance, range of space wave propagation or Line of sight, effective earth radius, Duct propagation	20

Text Books

- John D Kraus and RonalatoryMarhefka “Antennas and Wave Propagation” Tata Mc Graw Hill 2002
- C. A. Balanis “Antenna Theory Analysis and Design”, Wiley 3rd Edition, 2012.

Reference Books:

- “Antenna for all Applications 3rd edition” Krauss, Marhefka& Ahmed S khan, TMH publication.
- “Antenna & Wave Propagation” by K.D. Prasad, Satya Publication.
- Jordan and Balmain, “Electromagnetic waves and radiating systems”, PHI, 1968, Reprint 2003

Course Outcomes:After successful completion of the course students will be able to

1. Understand the basic characteristic parameters antenna and various modes of wave propagation and propagation effects in radio frequency.
2. Analyze the performance of different antennas.
3. Design the aperture, Patch, reflector, Broadband antennas for radio frequency communication.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO1, PSO2

BECE0003: DATA COMMUNICATION AND NETWORKS

Objective: This course enables the students

- To understand LAN, MAN, and WAN networks. Also, understand different layers of OSI and TCP/IP model.
- To explain different protocols used in data link, network, and transport layer.
- To compare guided and unguided transmission media.
- To distinguish different multiple access methods such as Random, CSMA/CD, CSMA/CA.
- To explain IPv4 and IPv6 addressing schemes.

Prerequisites: Digital communication system

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Networks & Data Communications:** OSI Model, TCP / IP, Transmission Media: Guided and unguided Media Review. **Switching:** Datagram Networks, Virtual Circuit Networks, Structure of a switch, Ethernet Physical Layer, **Data Link Layer:** Error detection and Correction. **Data Link Control:** Framing, Flow and Error Control Protocols, Noiseless Channel and Noisy Channel Protocol, HDLC, Point-to-Point Protocol.	14
II	**Multiple Access:** RANDOM, CDMA, CSMA/CD, CSMA/CA, Token Bus, Token Ring, FDDI, IEEE Standards 802.2,802.3, Hubs, Bridges, Routers. **Network Layer:** Design Issues. Adaptive and non-Adaptive Routing Algorithms. Congestion control Algorithms, IPV4 Addresses, Connecting Devices, Virtual LAN IPV6 Addresses, **and Transport Layer Protocol:** UDP and TCP, ATM Protocol Architecture.	12

Text Book:

- Behrouz A. Forouzan and Richard F. Gilberg, "*Computer Science – A Structured Programming Approach Using C*", C Language Learning, 2007.

Reference Books:

- K. N. King, "*C Programming a Modern Approach*", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, "*The C Programming Language*", PHI, 2nd Edition, 2011.
- P. Dey and M. Ghosh, "*Programming in C*", Oxford University Press 1st Edition, 2000.

Outcomes: After successful completion of the course students will be able to

CO1: Understand OSI, TCP/IP, various protocols, IPv4, IPv6 addressing schemes, and switching techniques.
CO2: Apply routing techniques in forming the routing table at each node of a network.
CO3: Analyze the efficiency of a network by using multiple access techniques including CSMA, CSMA/CD, CSMA/CA.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO3
CO2	PO1,PO2, PO3 /PSO1,PSO3
CO3	PO1,PO2, PO3 /PSO2,PSO3

BECE0004: MICROWAVE ENGINEERING

Objective:

1. To understand the performance of the Wave Guides and Resonators.
2. To apply the basic concepts of special type transmission lines.
3. To analyze the different Microwave Components.

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Microwave frequencies, Standard Frequency bands, Behaviour of circuits at conventional and microwave frequencies, Microwave applications. **Waveguide:** Review of Rectangular waveguide, Circular waveguides, Solutions of wave equation in cylindrical co-ordinates, Field distribution of TE &TM Modes, Dominant and Degenerate modes, Phase & group velocities, Wave impedances, Power transmission and Power losses. **Cavity Resonators:** Rectangular & circular cavities, coupling to Cavities, Quality factors of cavities. **Introduction to Strip lines, Micro strip lines and MMIC's.** **Microwave Passive Components:** Scattering matrix, Microwave T-Junctions: E-plane, H-plane and Hybrid Tees, Rat-Race Junction, Directional couplers. Attenuators, Phase Shifters, Microwave Bends, Corners and Twists, Irises. Microwave propagation in ferrites, Faraday rotation, Isolators, and Circulators.	22
II	**Solid State Microwave Devices:** PIN diode, Schottky barrier diode, Tunnel diode, Transferred electron devices (Gunn diode), Avalanche Transit –time devices: IMPATT Diode, TRAPATT Diode. **Microwave Tubes:** Limitation of conventional active devices at microwave frequency, Two cavity klystron, Reflex klystron, Magnetron, Traveling wave tube, backward wave oscillators: Principle of operation, Performance characteristic and their applications. **Microwave Measurements:** General set up of a microwave test bench, Slotted line carriage, VSWR meter, Microwave power measurements techniques, Measurement of frequency and wavelength, Impedance and losses. Measurement of S-parameters.	20

Text Books:

- Samuel Y. Liao, "*Microwave Devices and Circuits*", 3rd Ed, Pearson Education.

Reference Books:

- R.E Collin, "*Foundation for Microwave Engineering*", 2nd Ed., John Wiley India.
- D.M.Pozar ,"Microwave Engineering",John Wiley India.
- Das and S. K. Das, "*Microwave Engineering*", 2nd Edition, TMH.

Corse Outcomes: After successful completion of the course students will be able to

1. Understand the performance of the Wave Guides and Resonators.
2. Apply the basic concepts of special type transmission lines.
3. Analyze the different Microwave Components.
4. Examine the characteristics of high frequency diodes.
5. Analysis and performance of Microwave Tubes.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3
CO5	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3

BECE0071: MICROWAVE LAB

L–T–P: 0–0–2 **CREDITS: 01**

Objectives:

- To study the characteristics and applications of microwave frequency bands, propagationof E.M wave through waveguides, and understand the working of various microwave passive and active devices and circuits.

List of Experiments

Part – A: Microwave Test Bench Based (Any 6 Experiments):

1. Study of Reflex Klystron Characteristics.
2. Measurement of guide wavelength and frequency of the signal in a rectangular waveguide using slotted line carriage in a Microwave Bench.
3. Measurement of isolation coefficient, insertion loss and cross coupling of a circulator.
4. Determine the S-parameter of any three port Tee.
5. Determine the S-parameter of a Magic Tee.
6. Determine coupling coefficient, Insertion loss, Directivity and Isolation coefficient of any Multi-Hole directional coupler.
7. Study of waveguide horn and its radiation pattern and determination of the beam width.

Part – B: Mini project using Keysight Advanced Design system:

1. **Microwave Passive comoponents Design** such as Microwave Discrete and Microstrip Filter Design, Discrete and Microstrip Coupler Design, Microstrip and CPW Power Divider Design
2. **Microwave Active comoponents Design** such as Microwave Amplifier Design, Frequency Multiplier Design, Active Mixer Design, Microwave Oscillator Design, Power Amplifier Design

Course Outcomes

1. Examine the performance of microwave circuits and devices.
2. Design and simulate the passive and active microwave components as Filters, Couplers, Power Dividers, Amplifiers, Frequency Multiplier, Mixer, Oscillators and Power Amplifiers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2,PSO3
CO2	PO1,PO2, PO3, PO4 /PSO2,PSO3

BECE0005: OPTICAL COMMUNICATION

Objectives:

- Understand the various optical fiber modes, configurations and various signal degradation factors associated with optical fiber.
- Analyze the various optical sources and optical detectors and their use in the optical communication system.

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	**INTRODUCTION:** Overview of optical fiber communication- The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Optical fiber Modes and configuration, Mode theory for circular Waveguides, Step Index fibers, Graded Index fibers. **TRANSMISSION CHARACTERISTICS OF OPTICAL FIBER:** Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index. Fiber Material and its Fabrication Techniques Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Attenuation Measurements Techniques, Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion. Pulse broadening. Overall fiber dispersion in Multi mode and Single mode fibers, Fiber dispersion measurement techniques, Non linear effects. Optical fiber Connectors: Joints, Couplers and Isolators. **OPTICAL SOURCES:** Optical sources- LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Laser Diodes- Basic concepts, Classifications, Semiconductor injection Laser: Modes, Tunable and fixed laser, Threshold conditions, External quantum efficiency, Laser diode rate equations, resonant frequencies, reliability of LED & ILD.	22
II	**SOURCE TO FIBER POWER LAUNCHING:** Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling. **OPTICAL DETECTORS:** Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. **FIBER OPTIC RECEIVER AND MEASUREMENT:** Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog Receivers Various switching elements, OADM, OXC, CLOS architecture, MEMS, wavelength convertors.	21

Test Books:

- John M. Senior "*Optical Fiber Communication*", Pearson Education – Second Edition. **2007**

Reference Books:

- Gerd Keiser "Optical Fiber Communication", McGraw Hill – Third Edition. 2000
- Govind P. Agrawal "Fiber-optic communication systems", Wiley , Third Edition

Outcomes: After successful completion of the course students will be able to

1. Understand the various optical fiber modes, configurations and various signal degradation factors associated with optical fiber.
2. Demonstrate the ability to design a system, component or process as per needs and specification.
3. Analyze the various optical sources and optical detectors and their use in the optical communication system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1,PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1,PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3

BECE0072: OPTICAL COMMUNICATION LAB

Objectives:

- Implement the intensity modulation for optical sources including LED and LASER
- Evaluate the numerical aperture and bending loss for an optical fiber

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	1. To setting up fiber optic analog link. 2. Intensity modulation of LED output through an optical fiber. 3. Intensity modulation of Laser output through an optical fiber. 4. Study and measurement of numerical aperture of optical fiber. 5. Study and measurement of bending losses in optical fiber. 6. Study and measure DC characteristics of LED. 7. Study and measure DC characteristics of Laser. 8. Study and measure DC characteristics of photo detector	08

Outcomes: -After successful completion of the course students will be able to

1. Implement the intensity modulation for optical sources including LED and LASER
2. Evaluate the numerical aperture and bending loss for an optical fiber
3. Demonstrate the DC characteristic of optical sources (including LED and LASER) and optical photo-detector.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2,PSO3
CO2	PO1,PO2, PO3, PO4 /PSO2,PSO3
CO3	PO1,PO2, PO3, PO4 /PSO2,PSO3

BECE0006: WIRELESS COMMUNICATION

Credits: 03 **L–T–P: 3–0–0**

Course Objectives:

- Know the characteristic of wireless channel
- Learn the various cellular architectures
- Understand the concepts behind various digital signaling schemes for fading channels
- Be familiar the various multipath mitigation techniques
- Understand the various multiple antenna systems

Module No.	Contents	Teaching Hours
I	**Introduction to Wireless Communication Systems**, Modern Wireless Communication Systems. **Multiple Access techniques for wireless communications**: Frequency division multiple access, Time division multiple access, Spread spectrum multiple access. Code division multiple access, Frequency hopped multiple access, Space division multiple access, Packet radio, Packet radio protocols, Pure ALOHA, Slotted ALOHA. Carrier sense multiple access (CSMA) protocols, Reservation Protocols, Capture effect in Packet radio. **Cellular Systems-System Design Fundamentals:** Introduction, Frequency reuse**, c**hannel assignment strategies, Handoff strategies, Prioritizing handoffs, Practical handoff considerations, Interference and system capacity, Co-channel interference and system capacity, Channel planning for wireless system, Adjacent channel interference, Power control for reducing interference, Improving coverage & capacity in cellular system: Cell splitting, Sectoring, Repeaters for range extension, Microcell zone concept. **Mobile Radio Propagation: Large Scale Path Loss:** Introduction to radio wave propagation, Free-space propagation model, Propagation mechanism Reflection, Ground reflection (two ray model) , Diffraction, Fresnel zone geometry, Knife edge diffraction model, Multiple knife edge diffraction, Scattering, Radar cross section model, Practical link budget design using path loss model, Log distance path loss model , log normal shadowing, Determination of percentage of coverage area , Outdoor propagation models , Okumura model, Hata model, Indoor propagation model, Partition losses, log distance Path loss model., Ercisson multiple breakpoint model	21
II	**Mobile Radio Propagation: Small scale fading & multipath**: Factors influencing small scale fading, Doppler shift, Impulse response model of multipath channel, Small scale multipath measurements, Direct RF Pulse system, Spread spectrum sliding correlator channel sounding, Frequency domain channel sounding, , Parameters of mobile multipath Channels, Time coherence parameters, Coherence bandwidth, Doppler spread and Coherence time, Types of small scale fading, Flat fading , Frequency selective fading , Fast fading, Slow fading , Rayleigh & Ricean distribution. **Equalization**: Fundamentals of equalization, Training a generic adaptive equalizer, Equalizers in communication receiver, Survey of equalization techniques, Linear equalizers, Nonlinear equalizers, Algorithms for adaptive equalization, Zero forcing algorithm, Least mean square algorithm, Recursive least square algorithm, **Diversity techniques**: Space Diversity: Selection Diversity, Feedback or Scanning diversity, Maximal ratio combining., Equal gain combining, Polarization diversity, frequency diversity, Time diversity, Rake Receiver.	21

Text Books:

- T.S.Rappaport, "*Wireless Communication-Principles And Practice*", Pearson,Second Edition.
- R. Pandya, "*Mobile and Personal Communication System*", PHI.

Reference Books:

- Andrea Gold smith, "*Wireless Communications*", Cambridge University press.
- Andreas F. Molisch, "*Wireless Communications*", Wiley Student Edition.
- S.Haykin&M.Moher, "*Modern Wireless Communication*",Pearson,2005

Course Outcomes: After successfully completing the course students will be able to:

CO1: Understand the cellular design fundamentals, path-loss models, small scale fading, equalizers, diversity techniques and multiple access techniques.

CO2: Comprehend the cellular system design fundamentals.

CO3: Apply the concept of adaptive equalizer to compensate the errors present in the wireless channel.

CO4: Analyze the performance of wireless communication system in presence of large scale path-loss models and small scale fading.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1,PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1,PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1,PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO1,PSO2, PSO3

BECE0007: INFORMATION THEORY AND CODING

Credits: 03 **L–T–P: 3–0–0**

Course Objectives:

- To acquaint students with the basics of probability, information and its properties
- To familiarize students with different channel models and their capacity
- To teach different types of source coding techniques
- To explain various types of channel coding techniques

Module No.	Contents	Teaching Hours
I	**Introduction to Information Theory :-**Concept of amount of information, entropy, marginal, conditional and joint entropies and relation among entropies mutual information, information rate, Source coding Kraft's inequality, coding efficiency and redundancy, Noiseless coding theorem **Construction of basic source codes**: Shannon Fano Algorithm, Huffman coding, Channel capacity, redundancy and efficiency of a channel, binary symmetric channel (BSC), Binary error channel (BEC) capacity of band limited Gaussian channels, Shannon Hartley theorem, Bandwidth- SNR trade off, capacity of a channel of infinite bandwidth, Shannon's limit. Introduction to rings, fields, and Galois fields, Codes for error detection and correction, parity check coding linear block codes error detecting and correcting capabilities generator and parity check matrices, standard array and syndrome decoding, perfect codes.	22
II	Hamming codes encoding and decoding. Cyclic codes polynomial and matrix descriptions generation of cyclic codes, decoding of cyclic codes, BCH codes description and decoding, Reed Solomon Codes, Burst error correction.Convolution Codes, Trellis diagrams, transfer function and minimum free distance, Maximum likelihood decoding of convolution code, the Viterbi algorithm, Sequential decoding, Turbo codes, LDPC.	20

Text books:

- Thomas M. Cover, Joy A. Thomas, "*Elements of Information Theory* ", Wiley Publication.
- R Bose, "*Information Theory, Coding and Cryptography*", TMH publication

Reference Books:

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- Das Mullick Chatterjee "*Principles of Digital communication"* Wiley Eastern Ltd.
- P.S.Sathya Narayana "Concepts of Information Theory & Coding*"* Dynaram Publications, 2005.

Course Outcomes: After successfully completing the course students will be able to:

CO1: Understand the basics of probability, information theory and its properties, binary and non-binary source coding and channel coding.

CO2: Compute channel capacity for different types of channels including BSC, BEC and Gaussian channel.

CO3: Analyze the performance of source coding, channel coding techniques in image processing and wireless applications.

CO4: Construct, Linear block code, cyclic code, convolution code, LDPC code and Hamming codes.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1,PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1,PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1,PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO1,PSO2, PSO3

BECE0008: MULTI CARRIER COMMUNICATION

L–T–P: 3–0–0

Credits: 03

Course Objectives:

1. To characterize the basics of multipath fading channel.
2. To understand the concept of wireless communication generations.

Module No.	Contents	Teaching Hours
I	**Mobile Communications Systems**: Past, Present, and Future,4G Systems, Multicarrier Techniques for 4G Systems. **Characteristics of Multipath Fading Channels:** Introduction, Rayleigh and Ricean Fading Channels, Multipath Delay Profile, Multicarrier Techniques for 4G Mobile Communications, Frequency Selective and Frequency, Nonselective Fading Channels, Spaced-Time Correlation Function, Time Selective and Time Nonselective Fading Channels, Examples of Multipath Fading Channels. **OFDM :** The concept of multicarrier transmission, OFDM as multicarrier transmission ,Implementation by FFT , Orthogonal Multiplexing Principle	22
II	**OFDM:**Peak-to-Average Power Ratio and Sensitivity to Nonlinearity Sensitivity to Carrier Frequency Offset and Time-Varying Channels,Timing Offset and Cyclic Prefix Dimensioning. **Applications of OFDM:** Overview, MIMO Signal Model. Single-User MIMO Techniques , Multi-User Techniques **Future Research Directions**: OFCDM System, OFDM Adaptive Array Antennas, MIMO-OFDM	18

Text books:

- Shinsuke Hara and Ram jee Prasad, "*Multicarrier Techniques for 4G Mobile Communications*", Artech House universal personal communication.

Reference Books:

- Henrik Schulze and Christian L¨uders, "*Theory and Applications of OFDM and CDMA*", John Willey Publication.

Corse Outcomes:

Outcomes:

1. Understand the technologies of wireless communication generations.
2. Characterize the multipath fading channels and OFDM.
3. Analyze the performance of OFDM and multipath fading channels.
4. Compare the different multicarrier techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1,PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1,PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECE0073: MULTICARRIER COMMUNICATIONLAB

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Objectives:

- Implement the various digital modulation technique in Matlab.
- Analyze the performance of CDMA & OFDM system.

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I	• Realization of AM, PM and FM modulation and demodulation • Realization ASK, PSK and FSKmodulation and demodulation • Realization of QPSK modulation and demodulation • Realization of CDMA transmitter using MATLAB. • Realization of CDMA receiver using MATLAB. • Realization of OFDM transmitter using MATLAB. • Realization of ODMA receiver using MATLAB • BER calculation of CDMA system in AWGN channel environment using MATLAB. • BER calculation of OFDM system in AWGN channel environment using MATLAB.	22

Outcomes: -

1. Implement the various digital modulation technique in Matlab.
2. Analyze the performance of CDMA & OFDM system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO2,PSO3
CO2	PO1,PO2, PO3, PO4 /PSO2,PSO3

BECE0086: MULTICARRIER COMMUNICATION PROJECT

Projects List:

1) - Transmit diversity scheme in wireless communication.

In this project, the three receive diversity schemes – Selection combining, Equal Gain Combining and Maximal Ratio Combining have been widely used. All the three approaches used the antenna array at the receiver to improve the demodulation performance, with different levels of complexity. Now Time to move on to a transmit diversity scheme where the information is spread across multiple antennas at the transmitter. This is popularly abbreviated as Alamouti Space Time Block Coding (STBC).

2) - Inter Carrier Interference (ICI) in OFDM due to frequency offset.

This project deals in evaluation of the impact of frequency offset resulting in Inter Carrier Interference (ICI) while receiving an OFDM modulated symbol. First, the OFDM transmission and reception should be discussed, then the effect of frequency offset and the loss of orthogonality and resulting signal to noise ratio (SNR) loss due to the presence of frequency offset.

3) - BER for BPSK in OFDM with Rayleigh multipath channel.

This project deals with the performance of an OFDM modulated system in a frequency selective Rayleigh fading channel.

4) - IEEE 802.11ac – Very High Throughput for lower 6GHz band.

IEEE 802.11ac Very High Throughput (for <6GHz band) is an upcoming standard which is development by IEEE standardization committee. The mandate of Task Group AC is supposed to enhance the High Throughput rates achieved by 802.11n.

5) - Frequency offset estimation using 802.11a short preamble.

This is understood that an OFDM waveform is made of sum of multiple sinusoidal (also called subcarriers) each modulated independently. Let us try to understand the estimation of frequency offset in a typical OFDM receiver (using the short preamble specified per IEEE 802.11a specification as a reference).

Outcomes: -

1. Acquire the knowledge of diversity techniques used in multicarrier communication.
2. Implement the state of art in Inter Carrier Interference (ICI) in OFDM System.
3. Examine the BER performance of Rayleigh Multipath Channel.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4, PO9 /PSO2,PSO3
CO2	PO1,PO2, PO3, PO4, PO5, PO9 /PSO2,PSO3
CO3	PO1,PO2, PO3, PO4, PO5, PO9 /PSO2,PSO3

BECE0009: SPREAD SPECTRUM SYSTEM

Credits: 04 **L–T–P-J: 3–1–0-0**

Course Objectives:

- To provide the fundamentals of spreading techniques, spreading codes,code acquisition and tracking and analyze the performance of spread spectrum techniques.

Module No.	Content	Teaching Hours
I	**Spread spectrum Technique**: Principle of a Spread Spectrum(SS) **T**echnique and Code Division Multiple Access (CDMA),Advantages of SS Systems,Main Types of SS Techniques, Direct Sequence (DS) SS System, **Theory and Application of Pseudo Random Binary Sequences:** Properties of Random Binary Sequences, Autocorrelation of Binary Sequences, Crosscorrelation of Binary Sequences **Pseudo-Noise Sequences:** Linear Feedback Shift Register (LFSR),Properties of PN-Sequences, Preferred Pairs of PN Sequences. **Gold Sequences:** Properties and Generation of Gold Sequences **Maximum Length (ML)Sequences:**Properties and Generation of ML Sequences	21
II	**Frequency Hopped Spread Spectrum:** Definition/Description, Slow versus Fast Hopping, **Other SS Techniques:** Hybrid DS/FH/SS, chirp modulation, time hopping **Spreading Code Acquisition and Tracking:** Initial Code Acquisition, Acquisition strategies, Serial search, Parallel search, Multidwell detection, Matched filter acquisition, Code Tracking **Performance Spread Spectrum System:** Performance of Direct Sequence and Frequency Hopping Spread Spectrum systems	21

Text book:

1. Don Torrieri, Principles of Spread Spectrum system, Springer

References books:

2. Valery P. Ipatov, Spread Spectrum and CDMA Principles and Applications, John Willey Publication.
3. M. K. Simon, Spread Spectrum Handbook, Tata Mc Graw Hill Publication.

Course Outcomes: After successfully completing the course students will be able to

1. Understand principles and types of spread spectrum systems including Hybrid DS/FH/SS, chirp modulation, time hopping.
2. Explain the properties and generation of various spreading codes including random binary sequence, PN sequence, Gold codes, ML sequences.
3. Analyze the performance of DS-SS, FHSS, acquisition and tracking of spreading code.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3

BECE0010: SATELLITE COMMUNICATION

Objectives:

- To understand the basic concept of satellite communication.
- To design different class of satellites orbits.
- To analyze different modulation schemes used in satellite communication.

Credits: 03

L–T–P: 3–0–0

Module No.	Contents	Teaching Hours
I	**Orbital mechanics and Launchers:** Elements of Satellite Communication, Orbital mechanics, look angle and orbit determination, orbital perturbation, launches and launch vehicle, Orbital effects in communication system performance. **Satellites:** Satellite subsystems, attitude and orbit control systems, Telemetry Tracking Command & Monitoring, Power systems, Communication subsystem, satellite antennas **Earth Station.** Introduction, earth station subsystem, Singe and double conversion types of heterodyne earth stations.	21
II	**Satellite link design** Basic transmission theory, system noise temperature and G/T ratio, design of downlink, satellite systems using small earth station, Uplink design, design for specified Carrier to noise ratio. **Multiple access Techniques:** Introduction, space segment access methods, FDMA, TDMA, CDMA, SDMA, assignment methods. **Introduction of various satellite systems:** **VSAT:** Network architectures **Low earth orbit and non-geostationary satellite system:** Orbit considerations, **Direct broadcast satellite television and radio:** Digital DBS TV, DBS-TV system design, DBS-TV link budget, Error control in digital DBS-TV. Master control station and uplink, Installation of DBS-TV antenna, Satellite radio broadcasting, **Satellite navigation and Global positioning System:** GPS Position location principles, GPS Receiver and codes.	21

Text Books:

- Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt "Satellite Communications" 2nd Ed. John Wiley & Sons.

Reference Books:

1. Dennis Roddy "Satellite Communications" 3rd Ed. Mc-Graw-Hill.
2. Tri T. Ha. "*Digital Satellite Communications*" Tata-McGraw-Hill.1990.

Outcomes: After successfully completing the course students will be able to

1. Understand the basic principle and structure of satellite communication
2. Construct the satellite orbits.
3. Analyse the earth segment and space segment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3

BECE 0011: LONG TERM EVOLUTION

Credits: 03 **L–T–P: 3–0–0**

Course Objectives:

- To understand the different basic blocks of digital communication system.
- To design mathematical model of communication channels and digital signals.
- To analyze the principle of Orthogonal frequency division multiplexing.
- To analyze the performance of OFDM systems in the presence of noise and interference.
- To understand the basic concept of recent trends in wireless communication for future communication.

Module No.	Content	Teaching Hours
I	**Introduction and Background**: Long Term Evolution of UMTS ,Requirements and Targets for the Long Term Evolution **Technologies for the Long Term Evolution:** Multicarrier Technology, Multiple Antenna Technology, Packet-Switched RadioInterface, UserEquipment Capabilities. **Physical Layer for Downlink**: History of OFDM Development, Orthogonal Multiplexing Principle, Peak-to-Average Power Ratio and Sensitivity to Nonlinearity, Sensitivity to Carrier Frequency Offset and Time-Varying Channels, Timing Offset and Cyclic Prefix Dimensioning**.**	22
II	**Synchronization and Cell Search:** Coherent Detection, Non-Coherent Detection. **Multiple Antenna Technique:** Overview, MIMO Signal Model, Single-User MIMO Techniques, Multi-User Techniques. **Physical Layer for Uplink:** Introduction, SC-FDMA Transmission Structure, Time-Domain Signal Generation, Frequency-Domain Signal Generation **Uplink Capacity and Coverage:** Factors Affecting Uplink Capacity, LTE Uplink Capacity Evaluation, LTE Uplink Coverage and Link Budget.	20

Text Book:

- StefaniaSesia, Matthew Baker, “LTE – The UMTS Long Term Evolution”, Ist Edition, John Wiley & sons Ltd.

Reference Books:

- StefaniaSesia, Matthew Baker, “LTE – The UMTS Long Term Evolution”, Ist Edition, John Wiley & sons Ltd.

Course Outcomes: After successful completion of the course students will be able to

1. Represent the digital signal in baseband and pass-band format.
2. Understand the fundamentals of PAPR reduction techniques in OFDM
3. Represent the digital signal in vector space.
4. Design the OFDM transmitter and receiver scheme for digital communication.
5. Analyze the performance of OFDM communication in presence of noise.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3
CO5	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3

BECE0101: FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

Objective: This course enables the students

- To understand the human visual system, formation of the digital images, pixels neighboring relationship.
- To define various image intensity transformations such as image negative, log transformation, and piece-wise linear transformations.
- To apply image enhancement in both spatial and frequency domain. Also apply different morphological image operations on the given input image matrix.
- To explain image segmentation and compression techniques.

Prerequisites: Digital signal processing

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Contents	Teaching Hours
I	**Introduction and Fundamentals** Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization, Some Basic Relationships between Pixels, An Introduction to the color image model **Image Enhancement in Spatial domain** Introduction, Some Basic Intensity Transformation Functions, Histogram Equalization, Histogram Specification, Enhancement using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing - Mean filter, Ordered Statistic Filter, Sharpening – The Laplacian **Image Enhancement in Frequency Domain** Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters.	13
II	**Morphological Image Processing** Introduction, Logical Operations involving Binary Images, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Morphological Algorithms. **Image Segmentation:** Point, Line & Edge detection, Thresholding, Edge and Line Detection - Basic Edge Detection, Canny edge detection, Edge Linking - Hough Transform, Region-based segmentation, Region Extraction – Pixel based approach & Region based approach. **Fundamental Image Compression:** Coding redundancy, Image compression model, some basic compression methods, Image compression standards, Discrete Cosine Transform (DCT).	13

Text Book:

- R.C.Gonzalez and R.E.Woods (2008), "*Digital Image Processing*", 3rd Edition, Prentice Hall.

Reference Books:

- Anil K. Jain (1989). "*Fundamentals of Digital Image Processing*", Prentice-Hall.
- BhabatoshChanda, D. DuttaMajumder (2011). "*Digital Image Processing and Analysis*", PHI.

Outcome: Upon successful completion of this course, students will be able to

CO1: Understand the formation of the digital images, representation in spatial domain, and compression techniques.

CO2: Demonstrate the methodologies for image segmentation techniques like edge detection, thresholding, region growing, and region split and merge.

CO3: Apply adjacencies to define path, various intensity transformations, spatial filters like averaging, median, and Gaussian and morphological operations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO3
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO3

BECE0102: DIGITAL IMAGE PROCESSING

Objective: This course enables the students

- To define various image intensity transformations such as image negative, log transformation, and piece-wise linear transformations.
- To explain image enhancement in both spatial and frequency domain.
- To explain morphological operations and image segmentation techniques.

Prerequisites: Digital signal processing

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Contents	Teaching Hours
I	**Image Enhancement in Spatial domain** Introduction, Some Basic Intensity Transformation Functions, Histogram Equalization, Histogram Specification, Basics of Spatial Filtering, Smoothing - Mean filter, Ordered Statistic Filter, Sharpening – The Laplacian **Image Enhancement in Frequency Domain** Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters.	13
II	**Morphological Image Processing** Introduction, Logical Operations involving Binary Images, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Morphological Algorithms. **Image Segmentation:** Point, Line & Edge detection, Thresholding, Edge and Line Detection - Basic Edge Detection, Canny edge detection, Edge Linking - Hough Transform, Region-based segmentation, Region Extraction – Pixel based approach & Region based approach.	13

Text Book:

- R.C.Gonzalez and R.E.Woods (2008), "*Digital Image Processing*", 3rd Edition, Prentice Hall.

Reference Books:

- Anil K. Jain (1989). "*Fundamentals of Digital Image Processing*", Prentice-Hall.
- BhabatoshChanda, D. DuttaMajumder (2011). "*Digital Image Processing and Analysis*", PHI.

Outcome: Upon successful completion of this course, students will be able to:

CO1: Understand the image enhancement techniques including intensity transformation, histogram equalization, specification, and filtering methods.
CO2: Demonstrate the methodologies for image segmentation techniques like edge detection, thresholding, region growing, and region split and merge.
CO3: Apply binary morphological operations on input images.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO3
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO3

BECE0171: DIGITAL IMAGE PROCESSING LAB

Objective: This course enables the students

- To demonstrate the basic operations on images such as image reading, resizing, image negative, and geometric transformations in MATLAB environment.
- To apply the histogram equalization as a pre-processing step in image processing.
- To experiment with noise filtering methods such as median, low-pass, and high-pass filters on an arbitrary image

Prerequisites: Programming Skills – The student should have slight experience in a high level programming language such as MATLAB or C/C++.

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	1. Write program to read any image, resize it to 256 ×256. Apply square mask such that only middle part of the image is visible. 2. To perform image negative of 256 ×256 gray scale image 3. To check similarity between two images by using XOR/XNOR operations. 4. Take your own photograph in dark area. Improve its appearance using histogram equalization technique. 1. Write and execute program for geometric transformation of image (a) Translation (b) Scaling (c) Zooming (d) shrinking (e) Rotation 2. To add salt and pepper noise and apply median filter for its removal. 3. Write and execute programs to remove noise using 3×3 spatial low-pass and high pass filter 4. Write and execute programs for image frequency domain filtering (a) Apply FFT on given image (b) Perform low pass and high pass filtering in frequency domain	28

Outcome: Upon successful completion of this course, students will be able to:

CO1: Implement pre-processing techniques like averaging, median filtering, Gaussian filtering, contrast enhancement, and histogram equalization and mathematical equations on MATLAB.

CO2: Analyze the output image and change the required parameters to get desired result.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO3
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECE0186: DIGITAL IMAGE PROCESSING PROJECT

Objective: This course enables the students

- To recall the facts, basic terms, methods, and algorithms studied in digital image processing.
- To understand the MATLAB functions and their utility related with image processing.
- To apply image pre-processing, filtering in spatial and frequency domain, segmentation, morphological image operations in MATLAB environment.
- To develop programs based on lower level and higher level image processing.

Prerequisites:

- Programming Skills – The student should have slight experience in a high level programming language such as MATLAB or C/C++.
- Digital image processing

Credits: 02 **L–T–P-J: 0–0–0-8**

Module No.	Contents	Teaching Hours
I	Computer imaging system, Digital image representation, Classes and image types, Introduction to MATLAB. **Image pre-processing:** image enhancement, image transforms functions. Generating and plotting image histograms, histogram equalization. **Image filtering in spatial domain:** sharpening, smoothening. **Image filtering in frequency domain:** Basic steps in DFT filtering. conversion of spatial domain filters into frequency domain filters. **Program:** Image filtering **Image segmentation:** global thresholding, adaptive thresholding, region split & merge. **Program:** Image segmentation using thresholding methods. **Morphological image processing functions:** closing, opening, erosion, dilation, connected components, region filling. **Working on mini project:** application to image enhancement, segmentation. Present project to the class	32

Books:

1. Digital Image Processing, *R.C Gonzalez and R.E Woods*

2. Digital Image Processing Using MATLAB, *R.C Gonzalez and R.E Woods*
3. Fundamentals of Digital Image Processing, *A.K Jain*

Outcome: Upon successful completion of this course, students will be able to:

CO1: Apply high level tasks such as segmentation and morphological operation on input images to handle real-life problems related to object detection.
CO2: Design the algorithms as the solution to the problem related to pattern recognition and features extraction.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO3
CO2	PO1,PO2, PO3, PO4 . PO5, PO9 /PSO2, PSO3

BECE0103: BIOMEDICAL IMAGE PROCESSING

Credits: 03 **L–T–P: 3–0–0**

Objective:

- To understand the fundamentals of medical images like different modalities.
- To learn the different image enhancement techniques
- To represent the medical images in spatial and frequency domain
- To learn different image operation like edge detection, image growing, histogram equalization etc.
- To analyze features of medical images.

Module No.	Contents	Teaching Hours
I	Nature of biomedical images: body temperature as an image, trans-illumination, light and electron microscopy, different modalities of medical image, x-ray, tomography, ultrasonography, MRI. Image quality and information: characterization of image quality, optical density, dynamic range, contrast, histogram, entropy, Fourier Transform and spectral content. Removal of artifact, space domain local-statistic based filters, frequency domain filters, matrix representation of image processing.	21
II	Image enhancement: digital structure angiography, gray-scale transform, histrogram transformation, convolution mask operator, contrast enhancement. Detection of region of interest: thresholding and binarization, detection of point and line, edge detection, segmentation and region growing, detection of object of known geometry. Feature analysis: shape, shapes and contour, shape factors, Fourier descriptors, Texture analysis, texture in biomedical images, statistics of textures, texture energy, Fourier domain analysis of texture, audification and sonification of texture in image.	21

TEXT BOOKS:

- Rangaraj M. Rangayyan – Biomedical Signal Analysis. IEEE Press.

Outcomes: After the successful completion of this course students are able to

CO 1. Understand the different modalities, representation techniques of biomedical images.

CO 2. Demonstrate different preprocessing techniques to enhance the medical images.

CO 3. Apply the feature extraction techniques like image segmentation, ROI, texture, shape, contour, Fourier descriptor.

CO 4. Analyze the performance of algorithm used in medical images.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO5 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3 , PO5 /PSO1, PSO2, PSO3

BECE0104: ANALOG SIGNAL PROCESSING

Objective: This course enables the students

- To recall Kirchhoff's voltage and current law, op-amp, RLC circuits, signals and systems properties, and Laplace transform.
- To analyze the frequency response and properties of LTI system. Also learn s-domain circuit analysis.
- To understand ideal filters such as distortion-less and non-dispersive filters.
- To design low-pass Butterworth filters.

Prerequisites: Signals & Systems and Network analysis.

Credits: 03 **L–T–P-J: 3–0-0-0**

Module No.	Contents	Teaching Hours
I	Circuits Fundamentals: Voltage, Current, Power, Kirchhoff's Voltage and Current Laws. Circuits for Signal Processing: Operational Amplifiers, Signal Arithmetic, Differentiators and Integrators. Linearity, Time Invariance, and LTI Systems, First-Order *RC* and *RL* Circuits, n^{th} -Order LTI Systems, Ideal Circuit Elements and Simple Circuit Analysis. The Frequency Response of LTI Systems, Properties of Frequency Response of LTI Circuits, LTI System Response to Co-Sinusoidal Inputs, LTI System Response to Multi-frequency Inputs. Periodic Signals, Fourier Series, System Response to Periodic Inputs. Fourier Transform and LTI System Response to Energy Signals, Fourier Transform Pairs and Their Properties. Frequency-Domain Description of Signals.	14
II	LTI Circuit and System Response to Energy Signals. Laplace Transform and its Properties, Inverse Laplace Transform, *s*-Domain Circuit Analysis. Convolution, Sampling and Analog Signal Reconstruction, Impulse Response and Zero-State Response, BIBO Stability, Causality and LTIC Systems, Usefulness of Non-causal System Models, Delay Lines, Ideal Filters: Distortion-less and Non-dispersive, 1st- and 2nd-Order Filters, Low-Pass Butterworth Filter Design.	14

Text Book:

1. Analog Signals & Systems, Erhan Kudeki, David C. Munson, Jr, Pearson Education.

References:

1. Analog and digital signals & systems, R. K. Rao Yarlagadda, Springer.
2. Fundamentals of Analog and Digital Signal Processing, Li Tan, Jean Jiang.

Outcome: After the successful completion of this course students are able to

CO1: Understand the main components as the building blocks of the LTI system.
CO2: Apply various network theorems to determine the response of the circuit.
CO3: Analyze the analog circuit present in the LTI system on basis of the properties of frequency response.
CO4: Design ideal filters including distortion-less, non-dispersive, and low-pass Butterworth filter.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO3
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECE0105: ADAPTIVE SIGNAL PROCESSING

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Basic Concepts of signal processing, IIR & FIR Filters, Random variables, Random Processes, Filtered Random Process, Correlation, Co variance, Power spectrum, Cross Power Spectrum, Ergodi city, Time Averages and estimators **Linear Prediction:** Direct form linear prediction filtering, normal equations for linear prediction filtering, Levinson algorithm, Linear prediction lattice filtering.	21
II	**Digital Wiener Filtering:** Wiener smoothing prediction filter, Application of Weiner smoothing to noise cancelling. **LMS adaptive Filters:** LMS adaptive algorithm, Properties of LMS adaptive filters. **LS Adaptive Filters:** Godard algorithm, lattice **Blind Adaptive Filtering Techniques:** Cost Function, Higher Order Statistics & examples	21

Text book:

- S. Haykin "*Adaptive Filter theory*", Prentice Hall, 4th Edition, 2001

Reference Books:

- S. Haykin "*Adaptive Filter theory*", Prentice Hall, 4th Edition, 2001
- Ali H. Sayed "*Fundamentals of Adaptive Filtering*", John- Willey Publication, 2003.
- A. Papoulis, S. U. Pillai "*Probability, Random Variables and Stochastic Process*" TMH publication.

Outcomes:

1. Understand the basic concept of random signal, analog and digital filters,
2. Demonstrate the different structure of adaptive filters and the parametric methods for power spectrum estimation.
3. Apply the linear prediction, Levinson algorithm to design adaptive filter like Digital Wiener filter.
4. Analyze the performance of different adaptive filtering techniques including LMS, RLS and blind filtering techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3

BECE0106: BIOMEDICAL SIGNAL PROCESSING

Credits: 03 **L–T–P: 3–0–0**

Objectives:

- To introduce origin and characteristics of biomedical signals
- To provide an understanding on the application of signal processing concepts in analyzing biomedical signals
- To implement algorithms for various biomedical signal processing tasks Course Outcomes

Module No.	Contents	Teaching Hours
I	Preliminaries; Biomedical signal origin & dynamics (ECG), Filtering for Removal of artifacts Statistical Preliminaries; Time domain filtering (Synchronized Averaging, Moving Average), Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter), Optimal Filtering: The WeinerFilter, Adaptive Filtering SelectingAppropriate Filter, Data Compression Techniques:Cardiological Signal Processing: Pre-processing. QRS Detection Methods. Rhythm analysis. Arrhythmia detection Algorithms. Automated ECG Analysis. ECG Pattern Recognition. Heart rate variability analysis.	21
II	Adaptive Noise Canceling: Principles of Adaptive Noise Canceling. Adaptive Noise Canceling with the LMS adaptation Algorithm. Noise Canceling Method to Enhance ECG Monitoring. Fetal ECG Monitoring. Signal Averaging, polishing–mean and trend removal, linear prediction. Yule–walker (Y–W) equations. Their applications in ECG and EEG. Modeling of EEG Signals. Detection of spikes and spindles Detection of Alpha, Beta, and Gamma Waves. Auto Regressive (A.R.) modeling of seizure EEG. Sleep Stage analysis. Inverse Filtering. Least squares and polynomial modeling	21

TEXT BOOKS:

- Rangaraj M. Rangayyan – Biomedical Signal Analysis. IEEE Press, 2001.
- D. C. Reddy, Biomedical Signal Processing- principles, and techniques, Tata McGraw-Hill, 2005.
- Biomedical Digital Signal Processing, Willis J. Tompkins, PHI,

REFERENCE BOOKS:

- Weitkunat R, Digital Bio signal Processing, Elsevier, 1991.
- AkayM , Biomedical Signal Processing, Academic: Press 1994
- Cohen.A, Biomedical Signal Processing -Vol. I Time & Frequency Analysis, CRC Press, 1986.

Course Outcomes:

CO1: Understand techniques for various levels of tasks in biomedical signal analysis.
CO2: Demonstrate appropriate algorithms according to nature of the signal and acquisition characteristics.
CO3: Apply biomedical signal processing algorithms using appropriate tools.
CO4: Develop contemporary algorithms to address complex problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO5, PO9 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3, PO5, PO9 /PSO1, PSO2, PSO3

BECE0171: BIOMEDICAL SIGNAL PROCESSING LAB

L–T–P: 0–0–2

Credits: 01

Objective:

1. **To** implement different algorithm of signal enhancement in MatLab Environment.

Module No.	Content	Teaching Hours
I	1. Computation of Convolution and Correlation Sequences. 2. Analog and Digital Signal Conditioning. 3. Signal Averaging Improvement in the SNR Using Coherent Averaging. 4. Signal Averaging Improvement in the SNR Using Incoherent Averaging. 5. Exponential Averaging. 6. Data Polishing: Mean and Trend Removal. 7. Design or I I R Filter. 8. Design of F I R Filter. 9. PSD Estimation ECG, EEG 10. Implementation of IIR and FIR filters on ECG and EEG signals. 11. Noise Cancellation Techniques. 12. QRS Detections and HRV Analysis.	

Note: – Minimum of 10 experiments has to be conducted using MATLAB and Signal Processing Toolboxes.

Outcomes: After successful completion of the course, student should able to

1. Implement various signal enhancement techniques in MATLAB platform.
2. Design IIR and FIR filters depending on nature of biomedical signal.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO2, PSO3
CO2	PO1,PO2, PO3, PO5 /PSO2, PSO3

BECE0107: SPEECH PROCESSING

Credits: 03 **L–T–P: 3–0–0**

Objective:

- To provide the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
- To describe basic algorithms of speech analysis common to many applications.
- To give an overview of applications (recognition, synthesis, coding)

Module No.	Contents	Teaching Hours
I	**Digital Models for the Speech Signal:** Process of speech production, Acoustic theory of speech production, Lossless tube models, and Digital models for speech signals **Time Domain Models For Speech Processing:** Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech Vs silence discrimination using energy & zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing. **Digital Representations of the Speech Waveform:** Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, direct digital code conversion.	21
II	**Homomorphic Speech Processing:** Homomorphic systems for convolution, Complex cepstrum, Pitch detection, Formant estimation, Homomorphic vocoder. **Linear Predictive Coding of Speech:** Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Synthesis of speech from linear predictive parameters, Applications. **Speech Enhancement:** Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, Adaptive noise cancellation. **Speech Synthesis:** Principles of speech synthesis, Synthesizer	21

Text Book:

- L. R. Rabiner and R. W. Schafer, "Digital Processing of Speech Signals", Pearson Education (Asia) Pte. Ltd.

Reference Books:

- D. O'Shaughnessy, "Speech Communications: Human and Machine", Universities Press.
- L. R. Rabiner and B. Juang, "Fundamentals of Speech Recognition", Pearson Education (Asia) Pte. Ltd.
- Z. Li and M.S. Drew, "Fundamentals of Multimedia", Pearson Education (Asia) Pvt. Ltd.

Outcomes: After successful completion of the course, student should able to

1. Demonstrate the representation of the speech signals in time and discrete domain.
2. Apply the speech processing algorithm to enhance the quality of speech
3. Analyze the algorithm to recognize and synthesize the speech of speaker.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO2, PSO3

BECE0172: SPEECH PROCESSING LAB

Credits: 01 **L–T–P: 0–0–2**

Objective:

- To represent the speech in spatial and spectral domain
- To implement different speech processing algorithm in matlab environment

Module No.	Content	Teaching Hours
I	1. Handling Speech files in MATLAB. a. Read a speech file, its sampling rate and bits per sample. b. Write a speech file, at different sampling rates, at different bits per sample. c. Play a speech file at different sampling rates. 2. Fourier Transform and inverse Fourier Transform of Speech signals, plot of the spectrum of audio signals. 3. Convert the sampling rate associated with a speech file (MATLAB array) to adifferent sampling rate. 4. High-pass filter a speech file (MATLAB array) to eliminate hum and low frequency noise 5. plot a spectrogram of a speech file (MATLAB array) 6. plot a frame of speech and its associated spectral log magnitude	08

Course Outcomes:

After the successful completion of this course, the student will able to

CO 1: Analyze spectrum of speech signals.

CO 2: Implement speech processing algorithm in MATLAB environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO2, PSO3

BECE0201: FUNDAMENTALS OF HDL PROGRAMMING

Credits: 03 **L–T–P: 3–0–0**

Course Objectives:

- Utilize HDL to design and analyze digital systems
- Know different FPGA's and implementation methodologies.
- Learn field programmable gate array (FPGA) technologies and implementation of digital circuits using EDA Tools and FPGA board.
- Understand configuring and implementing digital embedded system, microcontrollers, and microprocessors on FPGA.

Module No.	Contents	Teaching Hours
I	**Design and analysis of typical digital circuits**: Array multiplier, Booth multiplier, Sequence Detector, Shifter design, Mux Tree **Memory management concepts :**Memory hierarchy, associative memory, and cache memory organization, Direct Mapped,Fully Associative ,Set Associative **Basic VHDL Language Elements.** Identifiers. Data Objects. Data Types. Operators. **Behavioral Modeling.** Entity Declaration. Architecture Body. Process Statement. Variable Assignment Statement. Signal Assignment Statement. Wait Statement. If Statement. Case Statement. Null Statement. Loop Statement. Exit Statement. Next Statement. Assertion Statement. Report, Multiple Processes. Postponed Processes.	20
II	**Dataflow Modeling.** Concurrent Signal Assignment Statement. Concurrent versus Sequential Signal Assignment. Delta Delay Revisited. Multiple Drivers. Conditional Signal Assignment Statement. Selected Signal Assignment Statement. The UNAFFECTED Value. Block Statement. Concurrent Assertion Statement. Value of a Signal. **Structural Modeling.** Component Declaration. Component Instantiation. Resolving Signal Values **Description and design of sequential circuits using VHDL**: Flip-flop, Register and Counter, Design of a Serial Adder with Accumulator, design of a Binary Multiplier, Multiplication of a Signed Binary Number. VHDL models for a multiplexer. **Generics and Configurations.** Generics. Why Configurations? Configuration Specification. Configuration Declaration. Default Rules. Conversion Functions. Direct Instantiation. Incremental Binding.	20

Text Book:

- "*Computer System Architecture*", M. Morris Mano, PHI.
- "*VHDL Programming*" by Example – By Douglas L.Perry., 4th Ed., TMH. 2002.
- "*A VHDL Primer"* - By J.Bhasker ., Pearson Education Asia, 11th Indian Reprint, 2004.

Reference Books:

- "*The Designer's Guide to VHDL*" - By Peter J. Ashenden, 2nd Ed., 1st Indian Reprint, Harcourt India Pvt. Ltd., 2001.
- "*Fundamentals of Digital Logic with VHDL Design*" – By Stephen Brown &ZvonkoVranesic., TMH. 2002
- "*Digital Systems Design using VHDL*" by Charles H.Roth Jr., PWS Pub.,1998
- "*Introductory VHDL*" : From Simulation to Synthesis – By SudhakarYalamanchili., Pearson Education Asia., 2001

Course Outcomes: After successfully completing the course students will be able to

CO-1: Understand the process, importance in VHDL and Apply the same in stimulus block and design block.

CO2: Analyze performance characteristics of memory hierarchy

CO3: Design and implement Sequential digital circuits as per the specifications.

CO4: Apply gate level modeling and data flow modeling procedures to develop the software modules for digital systems.

CO5: Analyze the behavior of structural, dataflow and behavior modeling procedures written in VHDL language.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO5	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3

BECE0202: DIGITAL SYSTEM DESIGN USING HDL

Objectives:

- Design combinational circuits.
- Design simple synchronous circuits including counters and state machines.
- Use VHDL to produce digital designs suitable for implementation on Xilinx.

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	**Design and analysis of typical digital circuits**: Array multiplier, Booth multiplier, Sequence Detector **Memory management concepts**Memory hierarchy, associative memory, and cache memory organization, Direct Mapped, Fully Associative ,Set Associative **Basic VHDL Language Elements.** Identifiers. Data Objects. Data Types. Operators. **Behavioral Modeling.** Entity Declaration. Architecture Body. Process Statement. Variable Assignment Statement. Signal Assignment Statement. Wait Statement. If Statement. Case Statement. Null Statement. Loop Statement. Exit Statement. Next Statement. Assertion Statement. Report, Multiple Processes. Postponed Processes. **Dataflow Modeling.** Concurrent Signal Assignment Statement. Concurrent versus Sequential Signal Assignment. Delta Delay Revisited. Multiple Drivers. Conditional Signal Assignment Statement. Selected Signal Assignment Statement. **Structural Modeling.** Component Declaration. Component Instantiation. Resolving Signal Values. **Introduction to VerilLog HDL:** Verilog as HDL, Levels of Design Description, Concurrency, **Language Constructs and Conventions:** Introduction, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators. **Gate Level Modeling:** Introduction, AND Gate Primitive, ModuleStructure, Other Gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances ofPrimitives, Design of Flip-Flops with Gate Primitives, Delay **Behavioural Modeling:** Introduction, Operations and Assignments, 'Intial' Construct, Assignments with Delays, 'Wait'Construct, MultipleAlwaysBlock, DesignsatBehavioural Level, Blocking and Non-Blocking Assignments, The 'Case' Statement, Simulation Flow, 'If' an 'if-Else' Constructs, 'Assign- De-Assign' Constructs, 'Repeat' Construct, for loop, 'The Disable' Construct, 'While Loop', Forever Loop, Parallel Blocks, Force-Release, Construct, Event.	28

Text Book:

- "*Computer System Architecture*", M. Morris Mano, PHI.
- "*VHDL Programming*" by Example – By Douglas L.Perry., 4th Ed., TMH. 2002.
- "*A VHDL Primer*" - By J.Bhasker ., Pearson Education Asia, 11th Indian Reprint, 2004.
- T.R. Padmanabhan, B Bala Tripura Sundari, Design Through Verilog HDL, Wiley 2009.
- ZainalabdienNavabi, Verliog Digital System Design,TMH, 2nd Edition.

Reference Books:

- "*The Designer's Guide to VHDL*" - By Peter J. Ashenden, 2nd Ed., 1st Indian Reprint, Harcourt India Pvt. Ltd., 2001.
- "*Fundamentals of Digital Logic with VHDL Design*" – By Stephen Brown &ZvonkoVranesic., TMH. 2002
- "*Digital Systems Design using VHDL*" by Charles H.Roth Jr., PWS Pub.,1998
- "*Introductory VHDL*" : From Simulation to Synthesis – By SudhakarYalamanchili., Pearson Education Asia., 2001

Course Outcomes: After successfully completing the course students will be able to

1. Understand the various primitives of Verilog and VHDL
.
2. Design combinational and sequential circuits using Verilog and VHDL.
3. Implement the digital logic circuits using HDL on Xilinx.
4. Analyze the performance parameters like leakage power, delays and area of digital circuits

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3, PO4, PO5 /PSO1, PSO2, PSO3

BECE0271 DIGITAL SYSTEM DESIGN USING HDL LAB

Objectives:

- *The objective of this Lab to design and simulate learn the Hardware Descriptive Language (Verilog/VHDL) and the fundamental principles of VLSI circuit design in digital domain.*
- *To provide hands on design experience with professional design (EDA) platforms.*

Credits: **Semester VI** **L–T–P: 0–0–0**

Module No.	Content	Teaching Hours
I	PART A **2 Bit-Counter** The purpose of this lab is to write a HDL description of 2-bit counter as a finite state machine (FSM). The 2-bit counter has several inputs such as clk, rst, enable, load, and should beable to reset, accept an input, count-up or count-down, etc... **Parallel to Serial Converter** The purpose of this lab is to write a HDL description of a parallel to serial converter as anFSMD. The parallel to serial converter will accept an eight-bit number and send one bit ofdata over the data line per clock cycle. There is also a go bit, which tells the converter tostart transmitting data. **VHDL Calculator** The purpose of this lab is to implement a finite state machine in VHDL to perform simplecalculations like addition, subtraction, and multiplication. **A Simplified HDL UART** In this lab the students design a UART to send data to the PC.	
II	PART B **I^{2}C Bus Lab** HDL implementation of I2C bus protocol **Design of A Hardware Multiplier** In this lab students are going to implement hardware multiplier using Sequential CircuitComponents. **ALU Design** The purpose of this lab is to build a 4/8 -bit ALU. The ALU is written behaviorally. It shouldtake in two numbers and be able to add the numbers, subtract the numbers, NOR thenumbers, or NAND the numbers.	

Outcomes: *After completion of Lab, student will be able to:*

1. *Write HDL code for basic as well as advanced digital integrated circuits.*
2. *Perform the Simulation and Analysis of Digital Blocks using EDA tools.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4, PO5 /PSO1, PSO2, PSO3

BECE0286: DIGITAL SYSTEM DESIGN USING HDL PROJECT

PART A

Programming using Verilog

1. HDL code to realize all the logic gates
2. HDL program for the following combinational designs
   a.2 to 4 decoder
   b. 8 to 3 (encoder without priority & with priority)
   c. 8 to 1 multiplexer
   D. 4 bit binary to gray converter
   e. De-multiplexer, comparator.
3. HDL code to realize 32 bit ALU
4. HDL Code for the following flipflops: SR, D, JK, and T
5. 4-bit binary ,BCD counters (Synchronous reset and asynchronous reset) and “any sequence” counters

PART B

Project

1. **Design and Verilog HDL Implementation of power efficient Carry Skip Adder Using Kogge-Stone Tree Logic**

   The portable equipment’s such as cellular phones, Personal Digital Assistant (PDA), and notebook personal computer, arise the need of effective circuit area and power efficient VLSI circuits. Addition is the most common and often used arithmetic operation in digital computers and also, it serves as a building block for synthesis all other arithmetic operations. In this Experiment, student will perform a carry skip adder (CSKA) structure that has a higher speed yet lower energy consumption compared with the conventional one. The speed enhancement is achieved by applying concatenation and incrementation schemes to improve the efficiency of the conventional CSKA (ConvCSKA) structure. In addition, instead of utilizing multiplexer logic, the structure makes use of AND-OR-Invert (AOI) and OR-AND-Invert (OAI) compound gates for the skip logic. The structure may be realized with both fixed stage size and variable stage size styles, wherein the latter further improves the speed and energy parameters of the adder.

2. **Low Power High Performance memory Design on FPGA Using Different IO Standard**

   In this experiment student will design energy efficient ROM/RAM. Concept of io standard will be used to further improve the performance.Student can use most energy efficient I/O standard among LVCMOS, HSLVDCI, HSTL, LVDCI_DV2 and SSTL. I/O standard is used to match impedance of transmission line, impedance of port and impedance of memory for avoidance of transmission line reflection. In naming convention of I/O Standard, LV is Low Voltage, HS is High Speed, DV2 is Half Impedance, CMOS is Complementary Metal Oxide Semiconductor, DCI is Digitally Control Impedance and SSTL is Stub… CONTINUE READING

3. **Design and Implementation of Vending Machine using Verilog HDL**
   The vending machines are used to dispenses small different products (snacks, ice creams, cold drinks etc.), when a coin is inserted. These machines can be implemented in different ways by using microcontroller and FPGA board. Here in this experiment, the student will learn an efficient algorithm for implementation of vending machine. Since FPGA based vending machine give fast response and uses less power than the microcontroller based vending machine.
4. **Efficient Implementation of 16-Bit Multiplier-Accumulator Using Radix-2 Modified Booth Algorithm and Spurious Power Suppression Technique(SPST) Adder Using Verilog.**
   In this experiment, student will learn a new multiplier-and-accumulator (MAC) architecture for low power and high speed arithmetic. High speed and low power MAC units are required for applications of digital signal processing like Fast Fourier Transform, Finite Impulse Response filters, convolution etc. For improving the speed and reducing the dynamic power, there is a need to reduce the glitches (1 to 0 transition) and spikes (0 to 1 transition). Adder designed using spurious power suppression technique (SPST) avoids the unwanted glitches and spikes, thus minimizing the switching power dissipation and hence the dynamic power. Radix -2 modified booth algorithm reduces the number of partial products to half by grouping of bits from the multiplier term, which improves the speed.
5. **Different IO Standard Based Green Multiplexer Design and Implementation using verilog**
   In this experiment student will use different IO Standard on the simplest VLSI circuit multiplexer and analyze the power dissipation with different class. Power and delay analysis will be performed.

Course Outcomes: After successfully completing the course students will be able to

CO1: Identify the suitable Abstraction level for a particular digital design.

C02: Design of Combinational and sequential logic circuits using HDL and its implementation on FPGA/CPLD

CO3: Analyze power, area, delay of various digital circuits for IoT applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4, PO5, PO(/PSO1, PSO2, PSO3
CO3	PO1,PO2, PO3, PO4, PO5, PO9 /PSO1, PSO2, PSO3

BECE0203: ANALOG VLSI DESIGN

Credits: 03 **L–T–P: 3–0–0**

Module No:	Content	Teaching Hours
I	Introduction to CMOS ICs, Body effect , small and large signal behavior of basic amplifier circuits, MOSFET Capacitances, Gain-boosed and Folded Cascode circuits, Cascode - Cascode current mirrors, Introduction to noise Representation of noise in circuits Noise in common-source and cascode circuits. Introduction to negative feedback, Nyquist plots and stability criteria, Loop gain and stability Single-stage opamp	12
II	Telescopic opamp, Folded-cascodeopamp Two-stage opamp, Fully-differential opamps, Phase Detectors, PLL building blocks,Charge pump PLL and its limitations,Introduction to VCOs	14

Text books:

- Design of Analog CMOS Integrated Circuits by BehzadRazavi, TMH Edition.
- CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition, 2010.

Reference books:

- Design of Analog CMOS Integrated Circuits by BehzadRazavi, TMH Edition.
- CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition, 2010.
- Analysis and Design of Analog Integrated Circuits by Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.
- Analog Integrated Circuit Design by David A. Johns, Ken Martin, Wiley Student Edition, 2013.

Course Outcomes: After successfully completing the course students will be able to

CO1: Understand the basic concepts of MOSFET

CO2: Apply the CMOS Technology to design and analysis of analog integrated circuits.

CO3: Design the single stage and two stage amplifier

CO4: Analyze the performance of analog circuits

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECE0204: VLSI TESTING AND TESTABILITY

Course Objective

- To know the various types of faults and also to study about fault detection, dominance
- To know the concepts of the test generation methods-DFT-BIST.
- To understand the fault diagnosis methods

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	**Fault modeling and simulation:** Logical fault models- stuck-at faults, bridging faults; Fault detection, equivalence and dominance; General fault simulation techniques serial, parallel, concurrent and deductive fault simulation, critical path tracing, statistical fault analysis. **Test pattern generation for combinational and Sequential circuits:** ATPG for single stuck-at faults and multiple stuck-at faults, various ATPG algorithms-D algorithm. ATPG for single stuck-at faults in sequential circuits;	20
II	**Test pattern generation for Sequential circuits:** Test generation using iterative array models-TG from known initial state, generation of self-initializing test sequences,Extended backtrace method; Simulation based TG; TG using RTL models; random test generation **Design for testability:** Ad-hoc design for testability- test points, oscillators and clocks, logical redundancy; Controllability and observability, boundary scan partial/ full scan, serial and non-serial scan; boundary scan standard; Compression techniques; Built-in self test (BIST).	20

Text book:

- Abramovici, M., Breuer, M. A. and Friedman, "*A. D. Digital Systems Testing And Testable Design*". IEEE press (Indian edition available through Jayco Publishing house), 2001.

Reference Books:

- Abramovici, M., Breuer, M. A. and Friedman, "*A. D. Digital Systems Testing And Testable Design*". IEEE press (Indian edition available through Jayco Publishing house), 2001.
- Bushnell and Agarwal, "*V. D. VLSI Testing*", Kluwer.
- Agarwal, V. D. and Seth, S. C. "*Test Generation For VLSI Chips*". IEEE computer society press.
- Hurst, S. L. "*VLSI Testing: Digital And Mixed Analog/Digital Techniques*". INSPEC/IEE, 1999.

CO1: Understand various types of fault model and the design for testability in various circuits

CO2: Demonstrate Fault Simulation techniques and Fault Diagnosis techniques.

CO3: Analyze the various combinational and sequential ATPG Techniques

CO4: Evaluate the significance of Built in Self-Test

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECE0205: INTEGRATED CIRCUIT TECHNOLOGY

Credits: 03 **L–T–P: 3–0–0**

Objectives:

1. To get processes on semiconductor fabrication technologies.
2. Explore principles and theory of micro- and nanofabrication.
3. Understanding the fabrication and be able to apply to future research and processes.

Module No.	Contents	Teaching Hours
I	Introduction To IC Technology: SSI, MSI, LSI, VLSI Integrated Circuits. Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Epitaxial: Vapour –Phase Epitaxial, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation. Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties. Lithography: Optical Lithography. Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition: Deposition Processes, Polysilicon , Silicon Dioxide, Silicon Nitride	21
II	Diffusion: Diffusion of Impurities in Silicon and Silicon Dioxide, DiffusionEquations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources , Sheet Resistance and its Measurement. Ion-Implantation: Ion-Implantation Technique, Range Theory, ImplantationEquipment. Metallization: Metallization Application, Metallization Choices, PhysicalVapour Deposition, Vacuum Deposition, Sputtering Apparatus. Packaging of VLSI devices: Package Types, Packaging Design Consideration, VLSI Assembly Technologies, Package Fabrication Technologies VLSI Process Integration: Fundamental Considerations For IC Processing, NMOS IC Technology, CMOS IC Technology, Bipolar IC Technology, Monolithic and Hybrid Integrated Circuits, IC Fabrication	21

Text Books:

- Stephen A. Campbell, “Fabrication Engineering at the micro and nano scale”, Oxford Univ Press.

Reference Books:

- S. M. Sze, “VLSI Technology”, 2nd Edition, McGraw –Hill Publication.
- S.K. Ghandhi, “VLSI Fabrication Principles”, 2nd Edition,. Willy-India Pvt. Ltd.
- J. D. Plummer, M. D. Deal and Peter B. Griffin, “Silicon VLSI Technology: Fundamentals, practice and modelling”, Pearson Education.
- Stephen A. Campbell, “Fabrication Engineering at the micro and nano scale”, Oxford Univ

Course Outcomes: After successfully completing the course students will be able to

1. Understand the fundamentals of crystal growth methods, Oxidation, Lithography, Deposition, Diffusion, Ion Implantation, Metallization methods.
2. Apply the fabrication processes implemented in a sequential manner for NMOS IC Technology, CMOS IC Technology, Bipolar IC Technology.
3. Compare the performance of low K and high K Dielectrics for integration of CMOS Technology, Bipolar IC Technology, Monolithic and Hybrid Integrated Circuits.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2,PSO3
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECE 0206: FUNDAMENTALS OF LOW-POWER VLSI CIRCUITS AND SYSTEMS

Objectives:

- Get knowledge of MOS circuits design.
- Analyze various types of power dissipation in CMOS circuits.
- Explain the various power reduction techniques.
- Design and implementation of power reduction techniques to minimize the power dissipation.

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	**Basics of MOS circuits:** MOS Structure, Operation of MOSFET, MOSFET - Current /Voltage Characteristics, Scaling and Small geometry effects and capacitances MOS Inverters, Resistive Load Inverter, Inverters with n-type MOSFET load-Depletion load inverter, Enhancement load, CMOS Inverter MOS Combinational Circuits - Different Logic Families, **Sources of Power dissipation:** Dynamic Power Dissipation, Short Circuit Power Switching Power, Gliching Power, Static Power Dissipation, Degrees of Freedom **Supply Voltage Scaling Approaches:** Device feature size scaling, Multi-Vdd Circuits, Architectural level approaches: Parallelism, Pipelining, Voltage scaling using high-level transformations, Dynamic voltage scaling, Power Management	23
II	**Switched Capacitance Minimization Approaches:** Hardware Software Tradeoff, Bus Encoding, Two's complement Vs Sign Magnitude, Architectural optimization, Clock Gating, Logic styles **Leakage Power Minimization Approaches:** Variable-threshold-voltage CMOS (VTCMOS) approach, Multi-threshold-voltage CMOS (MTCMOS) approach, Power gating, , Transistor stacking Dual-Vt assignment approach (DTCMOS)	22

Text Books:

- Sung Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata Mcgrag Hill.
- Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).
- Bellamour, and M. I. Elmasri, Low Power VLSI CMOS Circuit Design, Kluwer Academic Press, 1995.
- Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.

Reference Books:

- Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design ,Wiley-Interscience, 2000.

Course Outcomes: After successfully completing the course students will be able to

CO 1:- Understand the basic fundamental concepts of CMOS circuits, SRAMs/ DRAMs, power minimization approaches including device feature size scaling, multi-Vdd Circuits, architectural level approaches.

CO 2:- Explain the Short Channel Effects and switched capacitance minimization.

CO 3:- Analyze the performance of architectural approaches and scaling of CMOS integrated circuits with reference to speed and power dissipation.

CO 4:- Apply the power minimization techniques to reduce the power dissipation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECE0207: LOW-POWER VLSI CIRCUITS AND SYSTEMS

Objectives:

- Get knowledge about various types of power dissipation in CMOS circuits.
- Analyze the different supply voltage scaling approaches.
- Analyze the various power reduction techniques.
- Design and implementation of power reduction techniques to minimize the power dissipation.

L–T–P: 3–0–0

Module No.	Contents	Teaching Hours
I	**Fundamentals:** Need for Low Power Circuit Design, Sources of Power Dissipation: Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation **Supply Voltage Scaling Approaches:** Device feature size scaling, Multi-Vdd Circuits, Architectural level approaches: Parallelism, Pipelining, Voltage scaling using high-level transformations, Dynamic voltage scaling, Power Management	23
II	**Switched Capacitance Minimization Approaches:** Hardware Software Tradeoff, Bus Encoding, Two's complement Vs Sign Magnitude, Architectural optimization, Clock Gating, Logic styles **Leakage Power minimization Approaches:** Variable-threshold-voltage CMOS (VTCMOS) approach, Multi-threshold-voltage CMOS (MTCMOS) approach, Power gating, , Transistor stacking Dual-Vt assignment approach (DTCMOS)	22

Text Books:

- Sung Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata Mcgrag Hill.
- Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).
- Bellamour, and M. I. Elmasri, Low Power VLSI CMOS Circuit Design, Kluwer Academic Press, 1995.
- Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.

Reference Books:

- Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design,Wiley-Interscience, 2000.

Course Outcomes: After successfully completing the course students will be able to

CO 1:- Understand the basic fundamental concepts of CMOS circuits, SRAMs/ DRAMs, power minimization approaches including device feature size scaling, multi-Vdd Circuits, architectural level approaches.

CO 2:- Explain the Short Channel Effects and switched capacitance minimization.

CO 3:- Analyze the performance of architectural approaches and scaling of CMOS integrated circuits with reference to speed and power dissipation.

CO 4:- Apply the power minimization techniques to reduce the power dissipation.

CO 5:- Design of SRAM cell for Low power applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4, PO5 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4, PO5 /PSO2, PSO3
CO5	PO1,PO2, PO3, PO4, PO5,PO9 /PSO2, PSO3

BECE 0272: LOW POWER VLSI CIRCUITS AND SYSTEMS LAB

Credits: 1 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	PART A Draw the Layout, do circuit partitioning, placement and routing, circuit compaction, check DRC , Circuit extraction and finally post layout simulation for different combinational and sequential circuits.	
II	PART B Use the feature of automation test program generation, multilevel logic synthesis for design smaller application chips like multi bit parallel adder priority encoder, gereral purpose register, ALU, microcontroller/ dsp processor/ traffic light controller /sequential adder etc.	

Outcomes: *After completion of Lab, student will be able to:*

1. *Implement and simulate Write HDL code for basic as well as advanced digital integrated circuits.*
2. *Design and Analysis of Digital Blocks using EDA tools.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4, PO5 /PSO1, PSO2, PSO3

BECE0287: LOW-POWER VLSI CIRCUITS AND SYSTEMS PROJECT

Projects List:

VLSIL01 Low Power Dual Edge Triggered FLIP-FLOP

In the research of low power and low voltage VLSI circuits, the use and implementationof dual edge triggered flip flop (DETFF) has gained more attention at the gate level design. The main advantage of using DETFF is that it allows one to maintain a constantthroughput while operating at only half the clock frequency.Forthe performance evaluation of DETFF, the optimal delay, power consumption, and energy has to determine as the primary figures of merit.

VLSIL02 Implement of Full Adder of Cells Using 90nm Technology

The most widely used arithmetic operation in digital applications is addition.Full adder is the most important building block in digital signal processors and controllers as it is used in arithmetic logic circuit (ALU), in the floating point unit and in case of cache or memory access address generation. Asdensity of IC chip increases, power consumption also increases. Hence low power design is the primary requirement in the VLSI field.Reducing delay of a digital circuit is an important topic in logic design for efficient implementation of adder.

VLSIL03 Performance Analysis of Power Gating Designs in Low Power VLSI Circuits

The growing market of mobile, battery powered electronic systems (e.g., cellular phones, personal digital assistants, etc.) demands the design of microelectronic circuits with low power dissipation. As density and complexity of the chips continue to increase, the difficulty in providing power dissipation might limit the functionality of the computing systems. Especially, at nanometer level the power dissipation consumes about 35% of the chip power. The purpose of this project is to analyse the performance of one of the most trustful approaches to low power design called as "Power Gating".

VLSIL04 Design of Sequential Elements For Low Power Clocking System

Power consumption is a major bottleneck of system performance and is listed as one of the top three challenges in International Technology Roadmap for Semiconductor 2008. In practice, a large portion of the on chip power is consumed by the clock system which ismade of the clock distribution network and flop-flops. In this project Low Power Clocking System withLowPower Techniques will be implemented and analyzed.

VLSIL05 Energy Efficient Adiabatic Logic For Low Power VLSI Applications

The power dissipation has become a major design issue in VLSI circuits. As the system size is shrinking gradually it has become one of the prime concerns for the designers. The power dissipation can be reduced by introducing different design techniques. The power dissipation in adiabatic circuits can be minimized more than 90% as compared to conventional CMOS logic. In adiabatic circuit the charge stored in load capacitor is recovered while in conventional CMOS it is transferred to ground which causes wastage of energy. In this project Adiabatic Logic Circuits has to be implementing and analyze for Low Power VLSI Applications.

Course Outcomes: After successfully completing the course students will be able to

CO 1:-Identify the challenges in low power VLSI circuits.

CO 2:-Design a project based on power minimization techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4, PO5, PO9 /PSO1, PSO2, PSO3

BECE0208: FUNDAMENTALS OF RF INTEGRATED CIRCUITS

Objectives:

To provide students with RF circuit fundamentals for designing key building blocks in a typical RF transceiver.

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	Introduction; Advantages and challenges of high frequency design, S-Parameters, dB Units , Resonance in LC circuits, BW and Quality factor, Impedance transformations and matching; L-matches, Noise and Distortion: Harmonics and Intermodulation, Noise in RF Circuits, Resistor thermal noise , Noise in MOSFET: MOSFET Thermal noise , Flicker Noise.Transmitter Architectures: Transmitter versus Receiver metrics, Transmitter Architectures- Direct Conversion Transmitter, Power Amplifier Pulling and its different solutions, Heterodyne Transmitter, Issues in transmitter	21
II	Direct-Conversion Receiver, DC offset Problem and its solution, Heterodyne Receiver, Image frequency problem, Image reject filters ,Introduction to Low Noise Amplifier (LNA), Common Source LNA with inductive degeneration Mixer: Metrics , Single balanced and double balanced Mixers, Square law Mixer, Switching Mixers, , GilbertMixer,Voltage Controlled Oscillators, RC and LC oscillators, Power Amplifiers, linear versus constant envelope type power amplifiers	22

Text Books:

- RF Microelectronics by Behzad Razavi, Second Edition, Pearson.

Reference books:

- The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2006.
- VLSI for Wireless Communication by Bosco Leung (Publisher: Prentice Hall - Electronics and VLSI Series)

Course Outcomes: After successfully completing the course students will be able to

1. Understand the basic principle, tradeoffs and design issues of radio frequency circuits.
2. Analyze typical transceiver architectures including direct conversion & heterodyne.
3. Design key building blocks of RF transceivers, including standard matching circuits, low-noise amplifiers, mixers, power amplifiers and RF oscillators.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

BECE0209: RF INTEGRATED CIRCUITS

Objectives: To provide students with RF circuit fundamentals for designing key building blocks in a typical RF transceiver using CMOS technology.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Parallel and Series RLC Resonant Networks, Impedance matching , L Match-Low pass and High pass , T and Pi-match networks, RF Concepts: Non-linearity, Time variant, Harmonics, Gain Compression, Desensitization and Blocking, Cross-modulation, Intermodulation, Two tone test, Noise in RF circuits, Noise figure, Cascaded noise Figure, Transmitter : Cartesian and Polar Representation, Homodyne and Heterodyne architecture, Transmitter design issues: PA Pulling, Emission mask, Adjacent Channel Power, Spurs, noise	21
II	Direct conversion Receiver, Issues-DC offset, LO Self mixing, Interference leakage, 1/f noise, LO Pulling, Even order distortion I/Q mismatch, Heterodyne Receiver, low side and high side injection, IF frequency selection, Issues-Image Problem, Image reject filters, Image Reject Receivers-Hartley and Weaver Architectures, Low noise amplifier (LNA), LNA Topologies, Mixers, Two-port and Three port mixers, Gilbert Mixer, Sources of non-linearity and noise in Gilbert Mixers, ,Oscillators , RC and LC oscillators , Cross-coupled LC Oscillators ,Power Amplifiers-Linear and Switching type Power Amplifiers	22

Text Books:

- RF Microelectronics by BehzadRazavi. Pearson, 2012.

Reference Books:

- The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2006.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the principle, tradeoffs and design issues of radio frequency circuits.
2. Analyze typical transceiver architectures including direct conversion & heterodyne, Image reject
3. Design key building blocks of RF transceivers, including standard matching circuits, low-noise amplifiers, mixers, power amplifiers and RF oscillators.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4, PO5 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4, PO5 /PSO2, PSO3

BECE 0273: RF INTEGRATED CIRCUITS LAB

Credits: 01 **L–T–P: 0–0–2**

Objective:

- To perform the experiment *design and simulate the key building blocks of a typical RF Transceiver system.*

Module	Content	Teaching Hours
I	Design and Simulation of Different type of impedance matching networks(L, T and Pi)	24
	Design and Simulation of Low Noise Amplifier.	
	Design and Simulation of RF Mixer	
	Design and Simulation of Voltage Controlled Oscillator (VCO)	
	Design and Simulation of Phase Locked Loop (PLL)	
	Design and Simulation of Power Amplifier	

Outcomes: After successful completion of this course, student are able todesign and simulate

CO 1: Design and simulate L, Pi and T type impedance matching networks using high frequency simulation software environment including ADS, Cadence virtuoso

CO 2: Analyze the performance in terms of matching, linearity, noise of Low noise amplifiers, Mixer, Voltage Controlled Oscillator, Phase locked loop and power amplifiers using high frequency simulation software environment including ADS, Cadence virtuoso.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO2	PO1,PO2, PO3, PO4, PO5 /PSO1, PSO2, PSO3

BECE0288: RF Integrated Circuits Project

Projects on RF Integrated circuits:

RF Integrated Circuits course focus on design of RF module of a wireless transceiver system

1. Design low noise amplifier for transceiver system for a specific wireless standard.
2. Design of power amplifier for transceiver system for a specific wireless standard.
3. Design of switch for transceiver system for a specific wireless standard.
4. Design of mixer for transceiver system for a specific wireless standard.
5. Design of voltage controlled oscillator for transceiver system for a specific wireless standard.
6. Design of filter for transceiver system for a specific wireless standard.

Technologies:

- Silicon CMOS
- GaN-Suitable for power amplifiers

Popular Wireless Standards:

- Cellular networks: 5G
- Wireless Personal Area Networks:IEEE Std 802.15.4™-2015, WiMedia,BT/BLE
- Wireless Local Area Networks: IEEE 802.11/a/b/g/n/VHT
- Internet of Things (IOT):ZigBee, LTE-M, NB-IOT

References:

I. Razavi B. RF Microelectronics. Pearson Education International Upper Saddle River NJ; 2012
II. RFIC Design and Testing for Wireless Communications, A PragaTI(TI India Technical University) Course, July 18, 21, 22, 2008 by Vishwani D. Agrawal and Foster Dai, 200 Broun Hall, Auburn University Auburn, AL 36849-5201, USA

Outcomes: - After successful completion of this course, students are able to

1. Identify the design specifications of the components of RF transceiver blocks including LNA, mixer, oscillators, PLL and power amplifier for a specified wireless standard.
2. Design and simulate the any one the component of RF transceiver including LNA, mixer, oscillators, PLL and power amplifier for a specified wireless standard

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4, PO5, PO9 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4, PO5, PO9 /PSO2, PSO3

BECE0210: MICRO AND NANO DEVICES

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	Recapitulation of MOS scaling laws, Short channel effects, MOSFET models,Nano CMOS, Effects of gate oxide tunneling, Concept of EOT, high-k dielectrics, Effects of nanoscaling on MOSFET characteristics and performance, Technology trend, Advanced CMOS structures, SOI. Semiconductor heterojunctions; compound semiconductor and silicon-germanium heterostuctures, superlattice, HBTs, PETs, MESFETs, advanced solar cell structures.	21
II	Fundamental concepts of quantum structures and tunneling junctions, Nanotubes, Devices based on quantum wells, quantum wires/nanotubes and quantum dots – HEMTs, RTDs, CNT MOSFETs, SETs, Terahertz devices, advanced optoelectronic devices.Outline of nanofabrication – nanolithography, MBE, MOVPE; Introduction to molecular electronics.	21

Text Books:

- Yuan Taur, Tak H. Ning, Fundamentals of Modern VLSI devices, Cambridge University press
- B.R.Nag, Physics of Quantum well Devices, Springer Netherlands
- S. M. Sze, “VLSI Technology”, 2nd Edition, McGraw –Hill Publication.

Course Outcomes:

1. Understanding of basic concepts related to CMOS devices.
2. Analysis of effects of nano-scaling on MOSFET characteristics.
3. Study of advanced solar cell structure
4. Explain the various unit-processes in micro/nano fabrication

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO3	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3 /PSO1, PSO2, PSO3

BECE0301: ELECTRONICINSTRUMENTS AND MEASUREMENTS

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Theory of Measurement** Introduction, Performance characteristics: Static & dynamic characteristics, Standards, Error and uncertainty, Statistic analysis. **Transducers**: Classification, Transducers for the measurement of displacement, temperature, pressure, level and humidity etc. Signal conditioning aspects. **Analog Meters:** Current and voltage measurements, resistance measurements. **Bridge:** Various DC/ AC bridges and their applications. **Electronic Analog Meters**: Electronic analog DC ammeter and voltmeter, Electronic analog AC ammeter and voltmeter, Electronic mustimeter.	21
II	**Digital Meters:** Digital measurements, Specification of digital meters, Digital ammeter, voltmeter and wattmeter, Digital frequency measurement. **Display devices:** 7 Segment display, LCD, LED. **Oscilloscopes and Waveform Measurements** **Types of Oscilloscopes:** CRO, Dual beam, Dual trace & Sampling oscilloscope, DSO, Waveform measurements, Types of probes, Probe loading & measurement effect, Probe specifications. **Signal Analyzers** Signal Analyzers :Distortion Measurement and Spectrum Analyzers. **Advances and future trends in measurement technology**	21

Text Books:

- "*Electronic Instruments & Instrumentation Technology*" by MMS Anand, PHI Pvt. Ltd.
- "Instrumentation Measurement and Analysis " by B. C. Nakra and K. K. Chaudhary, McGraw-Hill.
- "*Electronic Instrumentation and Measurements*" by David A. Bell, 2nd Ed., PHI.

Reference Books:

- "*Modern Electronic Instrumentation and Measurement Techniques*" by Albert D. Helfric and William D. Cooper, PHI Pvt. Ltd.

Course Outcomes: After successfully completing the course students will be able to

CO 1 Understand of basics of measurement techniques, working of transducers and sensors.
CO 2 Demonstrate electronics/ electrical instruments, their use, peculiar errors associated with the instruments and how to minimize such errors.
CO 3 Explain the industrial and laboratory applications of instruments including analog and digital meters, signal generator and Oscilloscope.
CO 4 Analyze the error performance of measuring instruments.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO3	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3 /PSO1, PSO2, PSO3

BECE0302: MICROCONTROLLERS AND EMBEDDED SYSTEMS

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Embedded Systems:** Overview of Embedded Systems, Classification of Embedded Systems, Processor Embedded into a system, Embedded Hardware Units and Devices in system, Embedded Software, Design Process in Embedded System. **Embedded C:** Constants, Variables & Data Types, Operators: Types Of Operators, Bitwise Operators. Control Structures & Loops, Functions, Pointers. **PIC Architecture:** Introduction to PIC microcontrollers, PIC architecture, comparison of PIC with other CISC and RISC based systems and microprocessors, memory mapping. **C Programming and Interfacing with PIC:** **I/O Programming**: PIC I/O ports, I/O bit manipulation programming, timers/counters, programming to generate delay and wave form generation, I/O programming. **INTERFACING** of LED, 7 Segment Display, Introduction to 16x2 LCD, Commands of 16x2 LCD, Interfacing Circuit Description of 16x2 LCD, Programming of 16x2 LCD. **INTERFACING OF MOTORS:** Introduction to Motors, Programming & Controlling of motors in Embedded System.	21
II	**INTERFACING OF SWITCHES & KEYBOARD MATRIX:** Introduction to Switches & Keyboard Matrix, Interfacing Circuit of Switches & Keyboard Matrix, Programming of Keyboard Matrix & Switches, Controlling of LED's by using Switches, Key board Matrix & LCD Interfacing Program. **INTERFACING OF ADC:** Introduction to ADC, Programming of ADC **SENSOR INTERFACING:** Introduction to sensing devices, Interfacing of IR Sensors, Interfacing of Temperature Sensor. **Interfacing with ATMEGA328PB:** Interfacing of LED and 7 Segment Display, Introduction to 16x2 LCD, Commands of 16x2 LCD, Interfacing Circuit Description of 16x2 LCD, Programming of 16x2 LCD. **INTERFACING OF MOTORS:** Introduction to Motors, Programming & Controlling of motors in Embedded System. **INTERFACING OF SWITCHES & KEYBOARD MATRIX:** Introduction to Switches & Keyboard Matrix, Interfacing Circuit of Switches & Keyboard Matrix, Programming of Keyboard Matrix & Switches, Controlling of LED's by using Switches, Key board Matrix & LCD Interfacing Program. **INTERFACING OF ADC:** Introduction to ADC, Programming of ADC **SENSOR INTERFACING:** Introduction to sensing devices, Interfacing of IR Sensors, Interfacing of Temperature Sensor.	21

Text Book:

- John.B.Peatman, "*Design with Microcontrollers*", Person Education, 1st Edition, 2004.

Reference Books:

- David E. Simon, "*An Embedded Software Primer*", Pearson Education, 1999.
- V. Deshmukh, "*Microcontrollers: theory and applications*", Tata McGraw Hill, 12th reprint, 2005

Course Outcomes: After successfully completing the course students will be able to

CO 1 Understand the basics of embedded systems, internal Architecture of PIC and AVR microcontroller.
CO 2 Demonstrate both analog and digital sensor interfacing with a programmable platform.
CO 3 Analyze Peripherals and their programming aspects.
CO 4 Design techniques to develop software for embedded systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3, PO5 /PSO1, PSO2, PSO3

BECE0303: EMBEDDED SYSTEMS DESIGN

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Contents	Teaching Hours
I	**EMBEDDED SYSTEM INTRODUCTION:** Introduction to embedded system, embedded system architecture, classifications of embedded systems, challenges and design issues in embedded systems, fundamentals of embedded processor and microcontrollers, CISC vs. RISC, fundamentals of Vonneuman/Harvard architectures, types of microcontrollers. **Embedded C:** Constants, Variables & Data Types, Operators: Types Of Operators, Bitwise Operators. Control Structures & Loops, Functions, Pointers. **ARM Microcontroller:** Introduction to ARM CORTEX M4F based MCU (TIVA C Secirs**TM4C123G**), Architectural Overview, The Cortex-M4F Processor, Cortex-M4 Peripherals, JTAG Interface, System Exception Module, Hibernation Module, Internal Memory. General-Purpose Input/Outputs (GPIOs), General-Purpose Timers, Watchdog Timers, Analog-to-Digital Converter (ADC), Universal Asynchronous Receivers/Transmitters (UARTs), Pulse Width Modulator (PWM). **INTERFACING WITH TIVA :** Interfacing of LCD, **INTERFACING OF MOTORS:** Introduction to Motors, Programming & Controlling of motors in Embedded System.	21
II	**INTERFACING OF SWITCHES & KEYBOARD MATRIX:** Introduction to Switches & Keyboard Matrix, Interfacing Circuit of Switches & Keyboard Matrix, Programming of Keyboard Matrix & Switches, Controlling of LED's by using Switches, Key board Matrix & LCD Interfacing Program. **SENSOR INTERFACING:** Introduction to sensing devices, Interfacing of IR Sensors, Interfacing of Temperature Sensor. **INTERFACING WITH ATSAM :** Interfacing of LCD, **INTERFACING OF MOTORS:** Introduction to Motors, Programming & Controlling of motors in Embedded System. **INTERFACING OF SWITCHES & KEYBOARD MATRIX:** Introduction to Switches & Keyboard Matrix, Interfacing Circuit of Switches & Keyboard Matrix, Programming of Keyboard Matrix & Switches, Controlling of LED's by using Switches, Key board Matrix & LCD Interfacing Program. **SENSOR INTERFACING:** Introduction to sensing devices, Interfacing of IR Sensors, Interfacing of Temperature Sensor.	21

References books:

1. Joseph Yiu, The Definitive Guide to ARM® Cortex®-M0 and Cortex-M0+ Processors, 2015, 2nd Edition, Elsevier Science & Technology, UK.
2. Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide, 2010, Morgan Kaufmann Publishers.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the concept of embedded system, the key concepts of microcontroller including I/O, timers, interrupts and interaction with peripheral devices.
2. Demonstrate the programming in embedded C using code composer studio.
3. Explain the architecture, features of ARM processors and their interfacing with peripherals.
4. Apply the Interfacing techniques to connect ARM processors with the input and output devices including LEDs, LCDs, 7-segment display, keypad, dc motor and different sensors.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3, PO9 /PSO1, PSO2, PSO3

BECE0371: EMBEDDED SYSTEMS DESIGN LAB

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	1. To blink an LED with GPIO. 2. LED Control using a switch. 3. Running LED. 4. Interfacing Potentiometer using GPIO. 5. LCD Interfacing. 6. Keyboard and LCD Interfacing. 7. Interrupts & Collecting Sensor Information. 8. Distance Determination Using Ultrasonic Sensor. 9. Interfacing of Temperature Sensor. 10. Interfacing with Stepper Motor. 11. Speed Control of DC motor using PWM. 12. Servo Position Control with PWM. 13. Serial Communications Using UART. 14. RTC interfacing using I^2C.	24

Course Outcomes: After successfully completing the course students will be able to

1. Implement programs in embedded C and serial communication protocols (UART, I^2C) used for microcontroller.
2. Interface the commonly used peripherals with TIVA C TM4C123GH6PM.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4, PO9 /PSO1, PSO2, PSO3
CO2	PO1,PO2, PO3, PO5, PO9 /PSO1, PSO2, PSO3

BECE0386: EMBEDDED SYSTEMS PROJECT

Course objective: The project will introduce students to the challenge of Embedded Systems Design & Integration. The project is an example of '*hardware and software co-design'* and the scale of the task is such that it will require teamwork as a coordinated effort.

Course Outcomes: After successfully completing the course students will be able to

1. Recognize issues to be addressed in a combined hardware and software system design.
2. Apply hands-on experience in electronic circuit implementation for designing Embedded System and its testing.
3. Develop group working, including task sub-division and integration of individual contributions from the team.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO1, PSO2, PSO3

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BECE0304: INTELLIGENT SYSTEM

Course Objectives

- To provide students an opportunity to study the concepts of classical control design techniques like, P, PI and PID controllers.
- To provide students an opportunity to study the aspects of computational intelligence methods in depth to develop intelligent adaptive controllers.
- It focuses on designing intelligent controller using fuzzy logic, artificial neural networks, genetic algorithm, PSO and CSA techniques.
- It gives the analysis of learning systems in combination with feedback control systems, computer simulation of intelligent control systems to evaluate the performance.

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	Introduction: Conventional and Modern Control System, Intelligence, Soft and Hard Computing, Artificial Intelligence. Fuzzy Logic System: Introduction to crisp sets and fuzzy sets, examples. basic fuzzy set operation. Fuzzification, rule base, inference engine and defuzzification. Membership functions: triangular, trapezoidal, bell shaped, guassian, sigmoidal etc. Introduction to fuzzy logic modeling and control. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Fuzzy logic control for nonlinear time-delay system. Hybrid Fuzzy Control: Fuzzy P Controller, Fuzzy PI controller, Fuzzy PD and Fuzzy PD+I Control, Fuzzy Logic Toolbox in MATLAB.	**21**
III	Artificial Neural Networks: Concept of ANN and its basic mathematical model. Feed forward networks, Multi-layered neural network, Learning and Training the neural network. Radial basis function networks, Recurrent neural networks, Chebyshev neural network, System identification using neural network. Neural Network Toolbox in MATLAB, Neural Network based control. Genetic Algorithm-Basic concept of Genetic algorithm and detail algorithm steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept of some other search techniques like PSO and Cuckoo Search Algorithms for solving optimization problems in MATLAB.	**13**

BOOKs

1. Simon Haykin, "Neural Networks: Acomprehensive Foundation," Second edition, Prentice Hall.
2. J. H. Lilly, "Fuzzy Control and Identification," J Wiley.
3. Stuart J. Russel & Peter Norvig "Artificial intelligence: A modern approach," Prentice Hall.

Course Outcomes:

After successfully completing the course students will be able to:

1. Understand the classical control techniques for linear as well as nonlinear systems.
2. Apply the knowledge of fuzzy logic to design the controllers for nonlinear systems.
3. Analyzes the performance of different meta-heuristic optimization algorithms like GA, PSO and CSA.
4. Design an Artificial Neural Networks for training and testing purpose of a system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3, PO5 /PSO1, PSO2, PSO3

BECE0305: INDUSTRIAL PROCESS CONTROL

Course Objectives

- To learn the fundamental concepts of design aspects of process control.
- To develop the concepts of mathematical modeling of different nonlinear systems and its linearization.
- To learn the basics of feedback control schemes like P, I, D, PD, PI and PID controllers and its tuning.
- To build the concepts of final control elements like control valves.
- To develop the concepts of control systems with multiple loops like cascade control, selective control, split range control etc.

Credits: 03

Module No.	Contents	Teaching Hours
I	Introduction to process control; Design aspects of process control, mathematical modeling; Development of mathematical models. Modeling considerations for control purposes. Dynamic Behavior of Chemical Processes, Computer simulation and the linearization of nonlinear systems, Transfer functions and the input-output models. Dynamics and analysis of first, second and higher order systems. Feedback Control Schemes: P, I, D, PD, PI and PID controllers.	**21**
II	Dynamics and analysis of feedback-controlled processes. Stability analysis. Tuning of PID controller, Feedback response of the system with large dead time or inverse response Final control elements, Control Valves Control systems with multiple loops, cascade control, selective control, split range control, Feedforward and ratio control, Adaptive and inferential control, Control configuration of MIMO systems.	**21**

BOOKS:

1. Stephanopoulos, G.(1984)."Chemical process control: an introduction to theory and practice," Prentice-Hall, New Delhi.
2. Seborg, D.E.,Edgar, T.F. and Mellichamp, D.A.(2003). "Process dynamics and control," Wiley, New York.
3. Smith, C.A. and Corripio,A.B.(1997)."Principles and practice of automatic process control," Wiley, New York.
4. Johnson, C.D.(2006)."Process control instrumentation technology," Prentice-Hall, New Delhi.

Course Outcomes

After successfully completing the course students will be able to

1. Understand the knowledgeof Design an Artificial Neural Networks for training and testing purpose of a system.
2. Demonstrate the mathematical modeling of nonlinear systems and its linearization.
3. Design and tune the classical control techniques for linear as well as nonlinear systems.
4. Analyzes and apply the concept of different meta-heuristic optimization algorithms like GA, PSO and CSA.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO4 /PSO2, PSO3

BECE0372: INDUSTRIAL PROCESS CONTROL LAB

Credits: 01 **L–T–P: 0–0–2**

Lab No.	Contents	LAB Hours
I	1. Design of fundamental control structure for a second order LTI system on Lab VIEW. 2. Design of PID controller for a linear system and find the tuned gains of the controller on Lab VIEW. 3. Design of nonlinear PID controller for complex systems on Lab VIEW. 4. Study of fundamental structure of a level control system on process plant interfaced with Lab VIEW. 5. Study of fundamental structure of a flow control system on process plant interfaced with Lab VIEW.	24

Outcomes: *After completion of Lab, student will be able to:*

1. Implement the programming of controllers in Lab VIEW.
2. Simulate controllers using myRIO data acquisition system in a process control trainer including P, PD, PI and PID controllers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4, PO5 /PSO2, PSO3

BECE0387: INDUSTRIAL PROCESSC CONTROLPROJECT

1. Title: - A robust parallel control structure for nonlinear and uncertain systems
2. Title:- Design of self tuned fuzzy PD controller for uncertain and nonlinear system
3. Title: - Design of nonlinear PID controller for complex systems.
4. Title: - Design of gain scheduling controller for nonlinear uncertain system.
5. Title:-Parameters estimation of nonlinear system using meta-heuristic optimization algorithm.

Common Abstract: - The dynamical control of industrial systems has been quite important in process control industries for improving the performance and profitability of the industry. These industries potentially rely on various control loops present in a plant. These loops often include control of flow rate, level, pressure, temperature and ratio etc. which incorporate nonlinear and uncertain dynamics in the control loops. Due to this, considerable attention must be paid to effective control of these complex systems to significantly improve the productivity of overall process. For this, design of robust parallel control structure, fuzzy PD controller, nonlinear PID controller, gain scheduling etc. will help in the effective control of these complex systems.

Exact parameters of plant are necessary for efficient control design and for which meta-heuristic optimization algorithms can be used to find the accurate parameters of the plant.

Course Outcome: On the completion of this course the student will be able to

CO1-Implement the classical controllers for complex systems.

CO2-Design the intelligent adaptive controllers for complex systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4, PO9 /PSO2, PSO3
CO2	PO1,PO2, PO4, PO5, PO9 /PSO2, PSO3

BECE0306: DIGITAL CONTROL SYSTEM

Course Objectives:

- To introduce the students with the basic knowledge of A/D and D/A conversion
- To represent the system in Z-domain.
- To introduce the students about the design of digital controller.
- To study the stability analysis of digital control system

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	Introduction - Advantages of Digital control systems - Practical aspects of the choice of sampling rate and multirate sampling - Basic discrete time signals - Quantization – Sampling theorem – Data conversion and Quantization - Sampling process - Mathematical modeling - Data reconstruction and filtering of sampled signals – zero - order hold. z - transform and inverse z - transform, Relationship between s - plane and z - plane – Difference equation - Solution by recursion and z - transform - pulse transfer functions of the zero - order Hold and relationship between G(s) and G(z)– Bilinear transformation. Digital control systems - Pulse transfer function - z transform analysis of open loop, closed loop systems - Modified z Transform - transfer function - Stability of linear digital control systems -Stability tests. Root loci - Frequency domain analysis - Bode plots - Gain margin and phase margin - Design of Digital Control Systems based on Root Locus Technique. Cascade and feedback compensation by continuous data controllers - Digital controllers	22
II	Design using bilinear transformation - Realization of Digital PID controllers State equations of discrete data systems, solution of discrete state equations, State transition Matrix: z -transform method. Relation between state equations and transfer functions. Concepts on Controllability and Observability - Digital state observer: Design of the full order and reduced order state observer - Pole placement design by state feedback. Design of Dead beat Controller - some case studies - Stability analysis of discrete time systems based on Lyapunov approach.	21

Text Books:

Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, India, 1997.

References :

1. K. Ogata, Discrete Time Control Systems, PHI/Addison - Wesley Longman Pte. Ltd., India, Delhi, 1995.
2. B.C Kuo, Digital Control Systems, 2nd Edition, Oxford Univ Press, Inc., 1992.
3. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison - Wesley Longman, Inc., Menlo Park, CA , 1998.
4. John S. Baey, Fundamentals of Linear State Space Systems, Mc. Graw – Hill, 1st edition
5. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill, 1985.

Course Outcomes: After successful completion of the course students will be able to

1. Understand the basic components of digital control system signals.
2. Represent the system in discrete time domain.
3. Compute the response of the system to different discrete time input signals.
4. Analyze the stability of the system using Lyapunov approach.
5. Design the digital controller and compensator, state observer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3, PO5 /PSO1, PSO2, PSO3
CO5	PO1,PO2, PO3, PO5 /PSO1, PSO2, PSO3

BECE0307: MODERN CONTROL SYSTEM

Credits: 03 **L–T–P: 3–0–0**

Course Objectives

- To learn the fundamental concepts of state-space model of linear and non-linear system
- To evaluate the time response of linear and nonlinear systems.
- To learn the Liapunov stability analysis of nonlinear systems.
- To learn the concept of optimal control, LQR and Kalman filters.

Module No.	Contents	Teaching Hours
I	Basics of state space, eigen values, its invariance, diagonalization and Jordan canonical form, Caylay- Hamilton theorem, Computation of state transition matrix by a) Inverse Laplace method and b) Caylay Hamilton method, controllability and observability, state equations in Diagonal Canonical form, Decompositions of Transfer Functions, Effect of Pole-Zero cancellation in Transfer Function. Pole placement design, Ackermann's Formula for Pole Placement, design of full and reduced order state observers. Non-liner system: some common types of non linearlities, comparison of linear and non-linear systems, properties of nonlinear control systems, describing functions	20
II	Stability analysis using describing functions, limit cycle, Liapunov Stability Analysis of Linear Systems, Second method of Liapunov with four Stability theorems. Calculus of Variations: An Overview, Optimal Control Formulation using Calculus of Variations, Classical Numerical Methods for Optimal Control, Linear Quadratic Regulator (LQR) Design – I, Linear Quadratic Regulator (LQR) Design – II, An Overview of Kalman Filter Theory.	22

BOOKS:

1. I. J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publishers, Fourth Edition..

Course Outcomes: After successfully completing the course students will be able to

1. Represent the linear and nonlinear system in state space model.
2. compute the state response, observability and controllability of system.
3. Analyze the stability of nonlinear systems using Liapunov stability theorem.
4. Design state observer, LQR and Kalman Filter for the given system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3 /PSO1, PSO2
CO2	PO1,PO2, PO3 /PSO1, PSO2
CO3	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO4	PO1,PO2, PO3 /PSO1, PSO2, PSO3
CO5	PO1,PO2, PO3 /PSO1, PSO2, PSO3

BECE0308: INDUSTRIAL AUTOMATION

Credits: 03 **L–T–P-J: 3–0-0-0**

Module No.	Contents	Teaching Hours
I	Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. Functional block diagram of computer control systems.	14
II	Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies and isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions, PLC Basic Functions, register basics, timer functions, counter functions. PLC intermediate functions: Arithmetic functions, comparison functions, Skip and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance.	14
III	Design of interlocks and alarms using PLC. Distributed Control systems (DCS): Definition, Local Control Unit (LCU) architecture, LCU languages, LCU -Process interfacing issues, communication facilities, redundancy concept. Introduction–Evolution of signal standards –HART communication protocol –communication modes–HART networks. Introduction –General field bus architecture – basic requirements of field bus standard. Case studies of PLC and DCS with industrial applications.	14

Text Book:

1. John.W. Webb Ronald A Reis, "Programmable Logic Controllers –Principles and Applications", 4th Edition, Prentice Hall Inc., New Jersey.
2. Lukcas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the role of data loggers and the data acquisition system in a process control.
2. Analyze the programming of PLC for industrial application.
3. Design the controller programming using PLC.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO4, PO5 /PSO2, PSO3

BECE0373: PLC AUTOMATION LAB

Credits: 1 **L–T–P: 0–0–2**

Module No.	Content
I	1. To study and configure PLC modules. 2. To study and create basic Boolean logics. 3. To develop ladder program for simple logic gates (AND, OR, NOR, NAND, NOT, XOR, XNOR). 4. To construct PLC program using the bit logic instructions. 5. To study the operation of different types of timers and to use the PLC timers in a process control. 6. To study the operation of different types of counters and to use the PLC counters and timers in a process control. 7. To design basic open loop and closed loop control structure in PLC. 8. To study the pump control system. 9. To study pump control system using HMI. 10. To configure and study of Servo drive system.

Outcomes: After successfully completing the course students will be able to

1. Implement the concept of basic digital electronics and data manipulation use timer, counter, and other intermediate programming functions.
2. Design and program basic PLC circuits for entry-level PLC applications for open loop and closed loop process control system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO3, PO4, PO5 /PSO2, PSO3

BECE0311: ADAPTIVE CONTROL

Credits: 03 **L–T–P-J: 3–0-0-0**

Module No.	Contents	Teaching Hours
I	Concepts of adaptive control. Adaptive control structures: direct and indirect adaptation. Distinction between tune on demand and continuous adaptation. Gain scheduling, model reference adaptive control and adaptive pole placement control. Overview of industrial adaptive controllers. Case study: internal model adaptive control. Fuzzy adaptive control	**24**
II	ANN based adaptive controllers	**20**

BOOKS:

1. K. J. ASTROM, B. WITTENMARK, Adaptive control. Massachusetts: Addison-Wesley Publishing Company, 1996. 589 p.

Outcomes: *After completion of this course student will able to:*

1. Understand the concept of adaptive filter, fuzzy sets and neural network.
2. Analyze the performance of adaptive controller with fuzzy logic and neural networks.
3. Design the adaptive control algorithm in fuzzy logic.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 PO5/PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 PO5/PSO2, PSO3

BECJ0950: MINI PROJECT-I

Outcomes: *After completion of this course student will able to:*

CO 1:-Acquire practical knowledge within the chosen area of technology for project development.

CO 2:- Design and simulate the basic modules in chosen area of technology.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 PO9 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 PO9 /PSO2, PSO3

BECJ0951: MINI PROJECT-II

Outcomes: *After completion of this course student will able to:*

CO 1:-Acquire practical knowledge within the chosen area of technology for project development.

CO 2:- Design and simulate the basic modules in chosen area of technology.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 PO9 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 PO9 /PSO2, PSO3

BECJ0952: MINI PROJECT-III

Outcomes: *After completion of this course student will able to:*

CO 1:-Acquire practical knowledge within the chosen area of technology for project development.

CO 2:- Design and simulate the basic modules in chosen area of technology.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 PO9 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 PO9 /PSO2, PSO3

BECJ0971: PROJECT-I

Course Outcomes: After completing this course, students will able to:

CO1: Identify and Finalize problem statement by surveying variety of domains.
CO2: Perform requirement analysis and identify design methodologies
CO3: Apply advanced programming techniques
CO4: Present technical report by applying different visualization tools and Evaluation metrics.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO5 PO9 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3

BECJ0972: PROJECT-II

Outcomes: After completing this course, students will able to:

CO1: Review the literature and develop solutions for framed problem statement.
CO2: Implement hardware and/or software techniques for identified problems.
CO3: Test and analyze the modules of planned project.
CO4: Write technical report and deliver presentation.
CO5: Apply engineering and management principles to achieve project goal.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 PO9 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3
CO5	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3

BECJ0991: IDUSTRIAL TRAINING

Outcomes: After completing this course, students will able to:

1. Identify, formulate and model problems and find engineering solution based on a systems approach.
2. Develop and deliver a learning portfolio for presenting learning experiences and outcomes.
3. Demonstrate the awareness of the practical contexts in engineering.
4. Appreciate the work of others in an industrial or engineering sector.
5. Demonstrate good working practices to show a developing maturity and sense of responsibility

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 PO9 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3
CO5	PO1,PO2, PO3, PO5 PO9 /PSO2, PSO3

COURSE STRUCTURE

(w.e.f. Session 2020-21)

M.TECH

(ELECTRONICS & COMMUNICATION ENGG.)

(FULL TIME)

(CBCS)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

INSTITUTE OF ENGINEERING & TECHNOLOGY

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1.	MECC0001	Adaptive Signal Processing	4	0	0	4
2.	MECC0002	Communication Techniques	4	0	0	4
3.	MECC0003	CMOS Analog IC Design	4	0	0	4
4.	MECC0004	Digital Hardware Design	4	0	0	4
5.	MECC0005	Image Processing	4	0	0	4
6.	MECC0800	Signal Processing Lab	0	0	2	1
7.	MECC0801	Communication Lab	0	0	2	1
		TOTAL	**20**	**0**	**4**	**22**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1.	MECC0006	Low Power VLSI Design	4	0	0	4
2.	MECC1007	Intelligent Systems and Control	4	0	0	4
3.	MECC0008	RF and Microwave Techniques	4	0	0	4
4.		Elective-I	4	0	0	4
5.	MECC0802	HDL Programming Lab	0	0	2	1
6.	MECC0803	RF and Microwave Design Lab	0	0	2	1
7.	MECJ0950	Minor Project	0	0	0	3
		TOTAL	**16**	**0**	**4**	**21**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1.		Elective-II	4	0	0	4
2.		Elective-III	4	0	0	4
3.	MECJ0961	Seminar	0	0	2	1
4.	MECJ0971	Dissertation-I	0	0	8	4
		Total	**8**	**0**	**10**	**13**

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1.	MECJ0972	Dissertation- II	0	0	28	14
2.		**Total**	**0**	**0**	**28**	**14**

ELECTIVES

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			L	T	P	
1.	MECE0001	Embedded Systems	4	0	0	4
2.	MECE0002	Information Theory and Coding	4	0	0	4
3.	MECE0003	Application Specific Integrated Circuits	4	0	0	4
4.	MECE0004	Optimal Control System	4	0	0	4
5.	MECE0005	Digital Satellite Communication	4	0	0	4
6.	MECE0006	Advanced Data Network	4	0	0	4
7.	MECE0007	Speech Processing	4	0	0	4
8.	MECE0008	CMOS RF Integrated Circuits	4	0	0	4
9.	MECE0009	Optoelectronic Devices	4	0	0	4
10.	MECE0010	VLSI Testing and Testability	4	0	0	4
11.	MECE0011	Biomedical Signal Processing	4	0	0	4
12.	MECE0012	Wireless Communication and Networks	4	0	0	4
13.	MECE0013	CAD for VLSI Circuits	4	0	0	4
14.	MECE0014	Memory Design and Testing	4	0	0	4

COURSE STRUCTURE

(w.e.f. Session 2020-21)

M.Tech

(Electronics & Communication Engg.)

(Part Time)

(CBCS)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

INSTITUTE OF ENGINEERING & TECHNOLOGY

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	MECC0001	Adaptive Signal Processing	4	0	0	4
2.	MECC0002	Communication Techniques	4	0	0	4
3.	MECC0004	Digital Hardware Design	4	0	0	4
		TOTAL	**12**	**0**	**0**	**12**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	MECC0006	Low Power VLSI Design	4	0	0	4
2.	MECC0008	RF and Microwave Techniques	4	0	0	4
3	MECC0802	HDL Programming Lab	0	0	2	1
4.	MECC0803	RF and Microwave Design Lab	0	0	2	1
		TOTAL	**8**	**0**	**4**	**10**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	MECC0003	CMOS Analog IC Design	4	0	0	4
2.	MECC0005	Image Processing	4	0	0	4
3.	MECC0800	Signal Processing Lab	0	0	2	1
4	MECC0801	Communication Lab	0	0	2	1
5.	MECC0804	Seminar	0	0	2	1
		TOTAL	**8**	**0**	**6**	**11**

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	MECC1007	Intelligent Systems and Control	4	0	0	4
2.		Elective-I	4	0	0	4
4.	MECJ0950	Minor Project	0	0	6	3
		TOTAL	**8**	**0**	**6**	**11**

Fifth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.		Elective-II	4	0	0	4
2.		Elective-III	4	0	0	4
3.	MECJ0951	Dissertation-I	0	0	8	4
		Total	**8**	**0**	**8**	**12**

Sixth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	MECJ0952	Dissertation- II	0	0	28	14
		Total	**0**	**0**	**28**	**14**

ELECTIVES

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	MECE0001	Embedded Systems	4	0	0	4
2.	MECE0002	Information Theory and Coding	4	0	0	4
3.	MECE0003	Application Specific Integrated Circuits	4	0	0	4
4.	MECE0004	Optimal Control System	4	0	0	4
5.	MECE0005	Satellite Communication	4	0	0	4
6.	MECE0006	Advanced Data Network	4	0	0	4
7.	MECE0007	Speech Processing	4	0	0	4
8.	MECE0008	CMOS RF Integrated Circuits	4	0	0	4
9.	MECE0009	Optoelectronic Devices	4	0	0	4
10.	MECE0010	VLSI Testing and Testability	4	0	0	4
11.	MECE0011	Biomedical Signal Processing	4	0	0	4
12.	MECE0012	Wireless Communication and Networks	4	0	0	4
13.	MECE0013	CAD for VLSI Circuits	4	0	0	4
14.	MECE0014	Memory Design and Testing	4	0	0	4

MECC0001: ADAPTIVE SIGNAL PROCESSING

Objectives: To bring out the concepts related to stationary and non-stationary random signals to emphasize the importance of true estimation of power spectral density & introduce the design of linear and adaptive systems for filtering and linear prediction.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Basic Concepts of signal processing, IIR & FIR Filters, Random variables, Random Processes, Filtered Random Process, Correlation, Co variance, Power spectrum, Cross Power Spectrum, Ergodicity, Time Averages and estimators **Linear Prediction:** Direct form linear prediction filtering, normal equations for linear prediction filtering, Levinson algorithm, Linear prediction lattice filtering,	20
II	**Digital Wiener Filtering:** Wiener smoothing prediction filter, Application of Weiner smoothing to noise cancelling. **LMS adaptive Filters:** LMS adaptive algorithm, Properties of LMS adaptive filters. **LS Adaptive Filters:** Godard algorithm, lattice **Blind Adaptive Filtering Techniques:** Cost Function, Higher Order Statistics & examples	20

Text book:

- S. Haykin "*Adaptive Filter theory*", Prentice Hall, 4th Edition, 2001

Reference Books:

- "Adaptive filters, Theory and Application" B. Farhang-Boroujeny.
- Ali H. Sayed "*Fundamentals of Adaptive Filtering*", John- Willey Publication, 2003.
- A. Papoulis, S. U. Pillai "*Probability, Random Variables And Stochastic Process*" TMH publication.

Outcomes:

CO 1: Understand the parametric methods for power spectrum estimation.
CO 2: Demonstrate the stochastic signals in the vector space and linear prediction techniques.
Co 3: Apply the adaptive filtering techniques using LMS algorithm and the applications of adaptive filters.
CO 4: Design adaptive filters applying Different LMS Algorithms
CO5: Analyze performance of LMS and RLS algorithm.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO5	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0002: COMMUNICATION TECHNIQUES

Credits: 04 **L–T–P: 4–0–0**

Course Objectives:

- To understand the different basic blocks of digital communication system.
- To design mathematical model of communication channels and digital signals.
- To analyze the signal flow in a digital communication system.
- To analyze the performance of digital communication in the presence of noise and interference.

Module No.		Teaching Hours
I	**Introduction &**review of signals & systems: Elements of electrical communication system, communication channels & their characteristics, mathematical models for communication channels, frequency domain analysis of signals & systems: Fourier series & Fourier transform, power & energy, sampling of band limited signals, band pass signals. Random Theory: Probability & random variables, random processes, description of random processes, statistical averages, stationary processes, random processes & linear systems, random processes in frequency domain, power spectrum of stochastic processes, transmission over LTI systems, Gaussian & white processes, band limited processes and sampling, band pass processes. Digital transmission through additive white Gaussian noise channel-I : Geometric representation of signal waveforms, pulse amplitude modulation, two dimensional signal waveforms, baseband signals, two dimensional band pass signals-carrier phase modulation, two dimensional band pass signals-quadrature amplitude modulation, multidimensional signal waveforms, orthogonal, biorthogonal, simplex and binary coded, optimum receiver for digitally modulated signals in AWGN ,correlation type demodulator ,matched filter type demodulator, the optimum detector, demodulation & detection of carrier amplitude modulated signals, carrier phase modulated signals, quadrature amplitude modulated signals & frequency modulated signals	18
II	Digital transmission through additive white Gaussian noise Channel-I : Probability of error for signal detection in AWGN, probability of error for binary modulation, M-ary PAM, phase coherent PSK modulation, DPSK, QAM, M-ary orthogonal signals, M-ary biorthogonal signals, M-ary simplex Signals and non-coherent detection of FSK, comparison of modulation methods**.** Digital transmission through Band Limited AWGN Channels : Digital PAM transmission through band limited baseband channels, Digital transmission through band limited band pass channels, power spectrum of the baseband signal & carrier modulated signal, Signal design for band limited channels, design of band limited signals for zero ISI-The Nyquist criterion and controlled ISI-partial response signals, probability of error for detection of digital PAM with zero ISI & symbol by symbol detection of data with controlled ISI, probability of error for detection of partial response signals, modulation codes & modulation signals with memory, the maximum-likelihood sequence detection of partial response signals, the power spectrum of digital signals with memory, system design in the presence of channel distortion, design of transmitting & receiving filters for a known channel, channel equalization.	22

Text book:

- John G. Proakis and MasoudSalehi, “*Communication Systems Engineering*”, Second Edition, Pearson Education.

Reference Books:

- B.P. Lathi and Zhi Ding, “*Modern Digital And Analog Communication Systems”*, International fourth edition, Oxford University Press.
- S. Haykins, “*Communication Systems”,* 5th ed., John wiley.
- M. K. Simon, S. M. Hinedi and W. C. Lindsey, “*Digital Communication Techniques: Signaling And Detection”,* Prentice Hall India, N. Delhi, 1995.
- A.Papoulis, S.U.Pillai, Probability, “*Random Variables And Stochastic Processes”*, Mc Graw Hill, fourth Edition.

Course Outcomes:
After successful completion of the course students will be able to

1. Represent the digital signal in baseband and pass-band format.
2. Represent the digital signal in vector space.
3. Design the optimum receiver scheme for digital communication.
4. Analyze the performance of digital communication in presence of noise.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0003: CMOS Analog IC Design

Objectives:

- To provide in-depth understanding of the analog integrated circuit and building blocks
- To provide a basic idea on mixed signal IC design

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	Introduction to CMOS ICs, Body effect , small and large signal behavior of basic amplifier circuits, MOSFET Capacitances, Gain-boosed and Folded Cascode circuits, Cascode - Cascode current mirrors, Introduction to noise Representation of noise in circuits Noise in common-source and cascode circuits, Introduction to negative feedback, Nyquist plots and stability criteria, Loop gain and stability	21
II	Single-stage opamp, Telescopic opamp, Folded-cascode opamp,Two-stage opamp, Fully-differential Opamps, Phase Detectors, PLL building blocks, Charge pump PLL and its limitations, Introduction to VCOs	22

Text books:

- Design of Analog CMOS Integrated Circuits by Behzad Razavi, TMH Edition.
- CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition, 2010.

Reference books:

- Design of Analog CMOS Integrated Circuits by Behzad Razavi, TMH Edition.
- CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition, 2010.
- Analysis and Design of Analog Integrated Circuits by Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.
- Analog Integrated Circuit Design by David A. Johns, Ken Martin, Wiley Student Edition, 2013.

Course Outcomes: After successfully completing the course students will be able to

CO1: Demonstrate the design step the CMOS Technology

CO2: Explain the various amplifier topology including cascade and cascode

CO3: Analyze the performance of analog circuits

CO4: Design the analog IC design problems including the single and stage amplifier , PLL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0004 : DIGITAL HARDWARE DESIGN

Objectives: The Objective of the course is to provide deep understanding of the design methodologies for combinational, sequential digital systems, arithmetic and logic circuits, accumulator design, fault diagnosis, state finite machines and threshold logic design.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Review of basic building blocks of digital electronics, basic concepts. Analysis and design of typical combinational circuits, analysis and design of synchronous sequential circuits, design of arithmetic circuits, design of logic circuits, design of ALU; Accumulates design, status register, design of shifter, arithmetic and logic operation. Design of computer instructions, register transfer, bus and memory transfer, threshold logic hazards, reliable design and fault diagnosis	20
II	State equivalence and minimization of states, state assignment, state identification and fault detection experiments, asynchronous sequential circuits, races and hazards. Booth's Multiplier, control unit design methods, micro-programmed control, designed of a micro-programmed CPU, Realization with ROM, Main memory array design, auxiliary memory, memory hierarchy, associative memory, virtual memory and memory management concepts, cache memory organization, programmable logic devices, field programmable devices, hardware descriptive language.	20

Text books:

- "*Switching and Finite Automata Theory*" by Z. Kohavi, Tata McGraw-Hill, Second Edition
- "*Fundamentals of Switching Theory and Logic Design*" by Astola and Stankovic, Springer

Reference Books:

- "*Modern Computer Architecture*" by Rafiquzzaman and Chandra, Galgotia Publication.
- "*Computer System Architecture*", M. Morris Mano, PHI.
- Wayne Wolf, **Computers as Components; Principles of Embedded Computing System Design** – Harcourt India, Morgan Kaufman Publishers, First Indian Reprint 2001
- "*Frank Vahid and Tony Givargis*", **Embedded Systems Design – A unified Hardware /Software Introduction**, John Wiley, 2002.

Course Outcomes: After successfully completing the course students will be able to

1. Apply logic fundamentals in the design of memory.
2. Analyze and develop basic logic pipelined machines.
3. Design of state finite machines.
4. Synthesize working circuits using hardware design logic.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0005: IMAGE PROCESSING

Objectives: This course enables the students.

- To define image sampling, quantization, pixels relationship, features, descriptors and classification
- To explain various intensity transformations, image segmentation, various feature extraction approaches, and different classifiers.
- To apply various basic preprocessing (noise reduction, enhancement etc.) and advanced (segmentation, restoration and classification etc.) image processing algorithms.

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	**Digital Image Fundamentals:** Introduction, Fundamental of image, Elements of an image processing system, Image sampling & quantization; Basic relationships between pixels, mathematical Preliminaries: Image transforms. **Image Enhancement:** Gary-Scale Transformation, Piecewise linear transformation, Bit Plane slicing, Histogram Equalization, Enhancement by arithmetic Operations, Smoothing and sharpening using filters, Image blur type and quality measure , image enhancement in frequency domain. **Image Segmentation:** Thresholding, Object labeling, Edge Operators, Edge Linking by Adaptive Mathematical Morphology, Automatic Seeded Region Growing, A Top-Down Region Dividing Approach.	20
II	**Image coding:** Introduction to image coding, Some coding techniques: Run length coding, Bit-plane coding, Sub-band coding. **Image Representation and Description:** Boundary Extraction, Contour Representation, Skeletonization by Thinning, Medial Axis Transformation, Object Representation and Tolerance **Feature Extraction:** Fourier Descriptor and Moment Invariants, Shape Number and Hierarchical Features, Corner Detection, Hough Transform, Principal Component Analysis, Linear Discriminate Analysis, Feature Reduction in Input and Feature Spaces. **Classifiers:** Bayes Classifier, Support Vector Machine, K-Nearest neighbor (KNN) in Image Analysis. **Case Study:** Face Recognition, Medical Image. Watermarking, Finger Prints. (Any **TWO** case studies to be undertaken by each student)	20

Text books:

- Digital Image Processing, 3rd Edition, by R.C.Gonzalez and R.E.Woods, Prentice Hall
- Solomon, C and Breckon, T. “Fundamentals of Digital Image Processing: a Practical Approach with Examples in MATLAB. John Wiley and sons.
- Bhabatosh Chanda, D. Dutta Majumder (2011). “Digital Image Processing and Analysis”, PHI.

References:

- Fundamentals of Digital Image Processing, by Anil K. Jain, Prentice-Hall, 1989
- Digital Image Processing: An Algorithmic Approach; by MA Joshi PHI 2006
- Image Processing and Pattern Recognition: Fundamentals and Techniques, by Frank Y. Shi, Wiley , IEEE

Outcomes: Upon successful completion of this course, students will be able to

1. Define basic terminology of digital image processing.
2. Apply intensity transformations and spatial filtering.
3. Understand the methodologies for image segmentation, restoration etc.
4. Apply image-processing algorithms in practical applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2

MECC0006: LOW POWER VLSI DESIGN

Objectives:

- Identify sources of power in an IC.
- Identify the power reduction techniques based on technology independent and technology dependent.
- Power dissipation mechanism in various MOS logic style.
- Identify suitable techniques to reduce the power dissipation.
- Design memory circuits with low power dissipation.

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	**Fundamentals:** Need for Low Power Circuit Design, Sources of Power Dissipation: Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation **Short Channel Effects:** Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Switched Capacitance and minimization approaches. **Low Power Design:** Voltage scaling, VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. **Adders Design:** Standard Adder Cells, CMOS Adder's Architectures –Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders,	21
II	Low-Voltage Low-Power Design Techniques–Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles, **Low-Power Memories:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM, RAM fault modeling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing.	21

Text books:

- CMOS Digital Integrated Circuits by Analysis and Design by Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
- Low-Voltage, Low-Power VLSI Subsystems by Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

References:

- Introduction to VLSI Systems: A logic, Circuit and System Perspective by Ming-BOLIN, CRC Press, 2011.
- Low Power CMOS Design by Anantha Chandrakasan, IEEE Press/ Wiely International, 1998.
- Low Power CMOS VLSi Circuit Design by Kaushik Roy, Sharat C Prasad, John Wuiely& Sons, 2000.

Course Outcomes: After successfully completion of the Course, student will able to:

CO 1:- Explain the various types of power dissipation and short channel effects.

CO 2- Analyze the performance of architectural approaches and scaling of CMOS integrated circuits with reference to speed and power dissipation.

CO 3:- Apply the power minimization techniques to reduce the power dissipation.

CO 4:-Design of SRAM cell for Low power applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC1007: INTELLIGENT SYSTEMS AND CONTROL

Course Objectives

- To provide students an opportunity to study the concepts of classical control design techniques like, P, PI and PID controllers.
- To provide students an opportunity to study the aspects of computational intelligence methods in depth to develop intelligent adaptive controllers.
- It focuses on designing intelligent controller using fuzzy logic, artificial neural networks and genetic algorithm techniques.
- It gives the analysis of learning systems in combination with feedback control systems, computer simulation of intelligent control systems to evaluate the performance.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Artificial Intelligence:** Introduction, Intelligence, Soft and Hard Computing, Artificial Intelligence. **Non-linear control:** Primer- Norms of signals, Vectors and matrices, Positive definite function, Positive definite matrices, Continuous time state model, Discrete time state space model, Lyapunov stability theory, Non Linear control strategies. **Genetic Algorithm**-Basic concept of Genetic algorithm and detail algorithm steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. **Fuzzy Logic:** Classical sets, Fuzzy sets, Fuzzy rule base and approximate reasoning, Fuzzy logic control, System identification using T-S fuzzy models.	21
II	**Neural Networks:** Feed forward Networks, Multi-layered neural network, Redial basis function networks, Recurrent neural networks, Chebyshev neural network, System identification using neural networks. **Indirect adaptive control using neural networks:** Continuous time affine systems, Discrete-time affine system, Discrete-time Non-affine system, **Direct Adaptive Control using neural Networks:** Direct adaptive control single-input–single-output affine systems, Single-input-single output discrete time affine systems, Backstepping control. Neural network control of nonlinear discrete-time systems with actuator nonlinearities.	21

Text book:

- L. Behera, I. Kar, "Intelligent Systems & Control," Second Edition, Oxford University Press
- J. Stuart. Russell & Peter Norvig, "Artificial Intelligence: A Modern Approach," 1st Edition, Prentice Hall
- Simon Haykin, "Neural Networks: A Comprehensive Foundation," 2nd Edition, Prentice Hall

Reference Book:

- Jagannathan Sarangapani, "Neural Network Control of Nonlinear Discrete time Systems," Taylor & Francis

Course Outcomes: After successfully completing the course students will be able to

1. Understand the classical and fuzzy logic controllers for linear as well as nonlinear systems.
2. Apply the concept of meta-heuristic optimization algorithm like genetic algorithm for tuning of controller.
3. Analyze the stability and controllability of nonlinear systems.
4. Design an Artificial Neural Network for training and testing purpose of a system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2, PSO3

MECC0800: SIGNAL PROCESSING LAB

Objectives: This course enables the students

1. To understand the practical use of digital signal processing in IIR and FIR filter design
2. To apply image transforms, edge detection, spatial domain and frequency domain filtering.
3. To simulate signal and image processing algorithms in MATLAB

Credits: 02 **L–T–P: 0–0–4**

Module	Section	Content	Teaching Hours
I	A	**Digital Signal Processing** • Implement the FIR Filters for 2 KHz cutoff frequency and 2 KHz bandwidth for band pass filter. • Design FIR filter using Fourier series expansion method. • Implement IIR low pass filter for a 4 KHz cutoff frequency and compare it the FIR filter with the same type use chirp as input signal. • Verify Blackman and Hamming windowing techniques for square wave as an input which window will give good results. • Generate DTMF sequence 1234567890*# and observe its spectrogram.	42
	B	**Digital Image Processing** • Write the program for finding the digital negative of the image. • Write the program to plotting the Histogram of image. • Write the program to find the edge of the image. • Design and Implementation of Spatial domain filters for image processing. • Design and Implementation of Frequency domain filters for image processing.	

Outcomes:

Students are able to learn

1. Implement the different signal and image processing techniques
2. Debug and simulate algorithms in MATLAB.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3

MECC0801: COMMUNICATION LAB

Objectives:

To verify the function of various advance communication techniques for different channel conditions.

Credits: 02 **L–T–P: 0–0–4**

Module No.	Content	Teaching Hours
I	• Filtering of periodic signals • LTI system analysis in frequency domain • Bandpass to low pass transformation • Generation of samples of multivariate Gaussian process. • Power spectrum of random process and white process. • Linear filtering of random process • Low pass and band pass processes • Monte-carlo simulation of binary communication system • Optimum receiver for AWGN channels • Characterization of band limited channels and channel distortion • Characterization of Inter Symbol Interference. • Signal design for zero Inter Symbol Interference. • Implementation of matched filter. • Linear Equalizer • Nonlinear equalizer • Monte Carlo simulation of 16 QAM system	42

Outcomes: After the completion of the course, student will able to

CO 1: Implement perform signal processing related to communication.
CO 2: Design equalizer, matched filter corresponding to the communication signal.
CO 3: Analyze the performance of different subsystem used in communication.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3
CO3	PO1,PO2, PO4 /PSO2, PSO3

MECC0802: HDL PROGRAMMING LAB

Objectives:

The objective of this Lab to provide hands on design experience with professional design (EDA) platforms of VLSI circuit in digital domain.

Credits: 1 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**Xilinx ISE Based Experiments:** • Synthesis and simulation of Full Adder/ Subtractor • Synthesis and simulation of Multiplexer/ Demultiplexer • Synthesis and Simulation of 3 X 8 Decoder. • Synthesis and Simulation of Encoder/ Priority Encoder. • Synthesis and simulation of 2 bit comparator. • Synthesis and simulation of Upcounter/ Downcounter • Synthesis and Simulation of Flip Flop (D, and T). • Shift Register/ Universal Shift Register • Synthesis and Simulation of Memory – ROM, RAM • Design of a N- bit Register of Serial- in Serial –out, Serial in parallel out, Parallel in Serial out and Parallel in Parallel Out. • Array Multiplier/ Array Multiplier With Pipelining	24

Outcomes: *After completion of Lab, student will be able to:*

1. *Write HDL code for advanced digital integrated circuits.*
2. *Perform the Simulation and Analysis of Digital Blocks using EDA tools.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3

Course Outcomes: After successfully completing the course students will be able to

1. Employ the digital design tools for HDL design entry, simulation and synthesis.
2. Create and verify functionality of various gates at the transistor level.
3. Demonstrate knowledge and understanding of fundamental concepts of CAD tools (XILINX and TANNER).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3

MECC0006: LOW POWER VLSI DESIGN

Objectives:

- Identify sources of power in an IC.
- Identify the power reduction techniques based on technology independent and technology dependent.
- Power dissipation mechanism in various MOS logic style.
- Identify suitable techniques to reduce the power dissipation.
- Design memory circuits with low power dissipation.

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	**Fundamentals:** Need for Low Power Circuit Design, Sources of Power Dissipation: Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation **Short Channel Effects:** Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Switched Capacitance and minimization approaches. **Low Power Design:** Voltage scaling, VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. **Adders Design:** Standard Adder Cells, CMOS Adder's Architectures –Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders,	21
II	Low-Voltage Low-Power Design Techniques–Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles, **Low-Power Memories:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM, RAM fault modeling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing.	21

Text books:

- CMOS Digital Integrated Circuits by Analysis and Design by Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
- Low-Voltage, Low-Power VLSI Subsystems by Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

References:

- Introduction to VLSI Systems: A logic, Circuit and System Perspective by Ming-BOLIN, CRC Press, 2011.
- Low Power CMOS Design by Anantha Chandrakasan, IEEE Press/ Wiely International, 1998.
- Low Power CMOS VLSi Circuit Design by Kaushik Roy, Sharat C Prasad, John Wuiely& Sons, 2000.

Course Outcomes: After successfully completing the course students will be able to

1. The student will get to know the basics and advanced techniques in low power design which is a hot topic in todays market where the power plays major role.
2. The reduction in power dissipation by an IC earns a lot including reduction in size, cost and etc.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0007: INTELLIGENT SYSTEMS AND CONTROL

Objectives: The objective of this subject is to provide students an opportunity to study the aspects of computational intelligence methods in depth to develop intelligent adaptive controllers. In particular, this subject will focus on designing intelligent controller using fuzzy logic, artificial neural networks and genetic algorithm techniques. It will give the analysis of learning systems in combination with feedback control systems, computer simulation of intelligent control systems to evaluate the performance.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Artificial Intelligence:** Introduction, Intelligence, Soft and Hard Computing, Artificial Intelligence. **Non-linear control:** Primer- Norms of signals, Vectors and matrices, Positive definite function, Positive definite matrices, Continuous time state model, Discrete time state space model, Lyapunov stability theory, Non Linear control strategies. **Genetic Algorithm**-Basic concept of Genetic algorithm and detail algorithm steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. **Fuzzy Logic:** Classical sets, Fuzzy sets, Fuzzy rule base and approximate reasoning, Fuzzy logic control, System identification using T-S fuzzy models.	22
II	**Neural Networks:** Feed forward Networks, Multi-layered neural network, Redial basis function networks, Recurrent neural networks, Chebyshev neural network, System identification using neural networks. **Indirect adaptive control using neural networks:** Continuous time affine systems, Discrete-time affine system, Discrete-time Non-affine system, **Direct Adaptive Control using neural Networks:** Direct adaptive control single-input–single-output affine systems, Single-input-single output discrete time affine systems, Backstepping control. Neural network control of nonlinear discrete-time systems with actuator nonlinearities.	21

Text book:

- L. Behera, I. Kar, “Intelligent Systems & Control,” Second Edition, Oxford University Press
- J. Stuart. Russell & Peter Norvig, “Artificial Intelligence: A Modern Approach,” 1st Edition, Prentice Hall
- Simon Haykin, “Neural Networks: A Comprehensive Foundation,” 2nd Edition, Prentice Hall

Reference Book:

- Jagannathan Sarangapani, “Neural Network Control of Nonlinear Discrete time Systems,” Taylor & Francis
- Kevin Knight, Elaine Rich, B. Nair, “Artificial Intelligence,” Third Edition, Mc Graw Hill Education India.

Course Outcomes: After successfully completing the course students will be able to

1. To understand about the computational intelligence methods like artificial neural networks, fuzzy systems and meta-heuristic algorithm.
2. Be able to apply the concepts fuzzy logic methods for designing intelligent controllers for nonlinear complex systems.
3. Be able to apply the concepts of neural networks for parameter estimation and designing intelligent controllers for nonlinear complex systems.
4. To apply meta-heuristic algorithms for controller tuning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1,PO2, PO3, PO4 /PSO2, PSO3

MECC0008: RF AND MICROWAVE TECHNIQUES

Objectives

To learn principles of the RF and microwave techniques, transmission line theory, Scattering parameters, design and analysis of commonly used passive and active components in RF and Microwave frequency range.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Transmission Lines (TL)**: Introduction, Terminations of TLs, TL input impedance, time average power, Return and insertion losses, Voltage Standing Wave Ratio, The Smith chart and its applications **Impedance Matching and Tuning:** Transmission Line matching with lumped *L* Networks, Stub tuning, Quarter-wave transformer matching **Microwave Network Analysis:** S parameters and the Scattering matrix, Properties of S matrices, S parameters and time average power **Passive Components:** Properties of dividers and couplers, T-Junction power divider, Wilkinson power divider, Quadrature (90°) hybrid, The 180° hybrid	21
II	**Microwave Filters:** Microwave Filter design by insertion loss method, Scaling of low pass prototype filters, Filter transformations **Microwave Amplifier Design**: Two-port power gains, Amplifier Stability, Single-stage transistor amplifier: Design for maximum gain, Design for specific gain. **Frequency Multipliers, Oscillators and Mixers:** Frequency multipliers, RF oscillators, Microwave oscillators, Oscillator phase noise, Mixers: Mixer characteristics, Single ended mixer, Balanced mixer	21

Text book:

- David M. Pozar, "*Microwave Engineering*", Third Edition, Wiley India.

Reference Books:

- Reinhold Ludwig & Gene Bogdanov, **"** RF circuit design: theory and applications**"**, Prentice Hall, 2009
- Peter A. Rizzi, **"***Microwave engineering: passive circuits, Prentice Hall***",** 1988.
- Bharathi Bhat &Shiban K. Koul, "*Stripline-Like Transmission Lines For Microwave Integrated Circuits*", New Age International, 1989.

Course Outcomes: After successfully completing the course students will be able to

After successfully completing the course students will be able to

1. Analyze transmission line networks
2. Understand S-parameters and network characterization techniques using S- parameters.
3. Design Transmission Line matching with lumped *L* Networks, Stub tuning, Quarter-wave transformer matching
4. Design microwave filter by insertion loss method
5. Design of commonly used passive components as microwave power dividers, directional couplers filers, microwave amplifiers, frequency multipliers, oscillators and mixers in RF and microwave frequencies

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1,PO2, PO3, PO4 /PSO1, PSO2
CO5	PO1,PO2, PO3, PO4 /PSO1, PSO2

MECC0802: HDL PROGRAMMING LAB

Objectives:

The objective of this Lab to provide hands on design experience with professional design (EDA) platforms of VLSI circuit in digital domain.

Credits: 1 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**Xilinx ISE Based Experiments:** • Synthesis and simulation of Full Adder/ Subtractor • Synthesis and simulation of Multiplexer/ Demultiplexer • Synthesis and Simulation of 3 X 8 Decoder. • Synthesis and Simulation of Encoder/ Priority Encoder. • Synthesis and simulation of 2 bit comparator. • Synthesis and simulation of Upcounter/ Downcounter • Synthesis and Simulation of Flip Flop (D, and T). • Shift Register/ Universal Shift Register • Synthesis and Simulation of Memory – ROM, RAM • Design of a N- bit Register of Serial- in Serial –out, Serial in parallel out, Parallel in Serial out and Parallel in Parallel Out. • Array Multiplier/ Array Multiplier With Pipelining	24

Outcomes: *After completion of Lab, student will be able to:*

1. *Implement and simulate HDL code for advanced digital integrated circuits.*
2. *Analyze the combinational and sequential circuits using EDA tools.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1,PO2, PO4 /PSO2, PSO3

MECC0803: RF AND MICROWAVE DESIGN LAB

Objectives:

The objective of this Lab to provide hands on experience of design and analysis of passive and active devices commonly utilized in microwave subsystems

Credits: 1 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	• Simulationand Analysis of the Transmission Line under Different Load Conditions • Simulation and Analysis of S parameter of the Given Network • Design and simulation of Impedance Matching Network • Design and simulation of Power Divider • Design and simulation of Directional Coupler • Design and simulation of Microwave Filter • Design and simulation of Microwave Amplifier • Design and simulation of Low Noise Amplifier • Design and simulation of Microwave Mixer • Design and simulation of Microwave Oscillator	

Outcomes: *After completion of Lab, student will be able to*

1. Simulate and analyse the transmission lines under different load conditions
2. Design and simulate the RF and microwave passive devices such as power divider, directional coupler and filter.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1, PO2, PO4 /PSO2, PSO3

MECE0001: EMBEDDED SYSTEMS

Objectives: The course intends to develop an understanding of the technologies behind the embedded computing systems and also provide overview of various Microcontrollers, Real time operating system and advanced architectures like ARM processor.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Embedded Systems** Overview of Embedded Systems, Classification of Embedded Systems, Processor Embedded into a system, Embedded Hardware Units and Devices in system, Embedded Software, Design Process in Embedded System. **Overview of Microcontroller:** Microcontroller and Embedded Processors, Overview of 8051 Microcontroller family: Architecture, Input/output Ports and Circuits, External Memory, Counters and Timers. The program Counter and ROM Spaces in the 8051, Data types, 8051 Flag Bits ad PSW Register, 8051 Register Banks **8051 Assembly language programming** 8051-Instruction set, addressing modes, accessing memory using various addressing modes, Arithmetic instructions and programs, Logical instructions, BCD and ASCII application programs, Single-bit instruction programming, Reading input pins vs. port Latch, Programming of 8051 Timers, Counter Programming . Time delay generations and calculations. 8051 interrupts, Programming of timer interrupts, Programming of External hardware interrupts, Programming of the serial communication interrupts, interrupt priority in the 8051.	21
II	**Interfacing with 8051:** Interfacing an LCD to the 8051, 8051 interfacing to ADC, Sensors, Interfacing a Stepper Motor, 8051 interfacing to the keyboard, Interfacing a DAC to the 8051. **PIC Microcontroller** Introduction: PIC microcontroller features, PIC Architecture, Program memory, Addressing Modes, Instruction set, Instruction Format, Byte-Oriented Instructions, Bit-Oriented Instructions, Literal Instructions, Control Instructions **Advanced Microcontrollers**: Only brief general architecture of AVR, and ARM microcontrollers. **Design, Development and Debugging Tools for Microcontroller based Systems:** Software tools like Cross assembler, compiler, debuggers, simulators and hardware tools like In-Circuit Emulators(ICE), Emulators, Logic Analyzers etc.	21

Text Books:

- Muhammad Ali Mazidi, Janice GillispieMazidi., "The 8051 Microcontroller and Embedded systems", Person Education, 2nd Edition, 2004.
- John.B.Peatman, "Design with Microcontrollers", Person Education, 1st Edition, 2004.

Reference Books:

- Ayala, Kenneth, "The 8051 Microcontroller", Thomson, 2nd Edition, 2000.
- David E. Simon, “An Embedded Software Primer”, Pearson Education, 1999.
- V. Deshmukh, "Microcontrollers: theory and applications", Tata Mc Graw Hill, 12th reprint, 2005.

Course Outcomes: After successfully completing the course students will be able to

1. Can understand what is embedded systems and the embedded system design process.
2. Can understand the basic 8051 and PIC microcontrollers architecture and programming.
3. Can understand the various applications like blinking of LED Digital logic, Precision Analog and serial Communications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO1, PSO2

MECE0002: INFORMATION THEORY & CODING

Objectives: The course aims at providing students a foundation in information theory – the theory that provides quantitative measures of information and allows us to analyze and characterize the fundamental limits of communication systems.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Information Theory :-**Concept of amount of information, entropy, marginal, conditional and joint entropies and relation among entropies mutual information, information rate, Source coding Kraft's inequality, coding efficiency and redundancy, Noiseless coding theorem **Construction of basic sourcecodes**: Shannon Fano Algorithm, Huffman coding, Channel capacity, redundancy and efficiency of a channel, binary symmetric channel (BSC), Binary error channel (BEC) capacity of band limited Gaussian channels, Shannon Hartley theorem, Bandwidth- SNR trade off, capacity of a channel of infinite bandwidth, Shannon's limit, Introduction to rings, fields, and Galois fields,	20
II	Codes for error detection and correction, parity check coding linear block codes error detecting and correcting capabilities generator and parity check matrices, standard array and syndrome decoding, perfect codes, Hamming codes encoding and decoding, cyclic codes polynomial and matrix descriptions generation of cyclic codes, decoding of cyclic codes, BCH codes description and decoding, Reed Solomon Codes, Burst error correction. Convolution Codes, Trellis diagrams, transfer function and minimum free distance, Maximum likelihood decoding of convolution code, the Viterbi algorithm, Sequential decoding, Cryptography, LDPC, Space time codes, Bar codes	22

Text book:

- R Bose, "*Information Theory, Coding and Cryptography*", TMH publication.

Reference Books:

- Das Mullick Chatterjee "*Principles of Digital communication"* Wiley Eastern Ltd.
- P.S. Sathya Narayana "*Concepts of Information Theory & Coding "*Dynaram Publications, 2005.

Outcomes:

1. Understand the basic notions of information and channel capacity.
2. Demonstrate different source and channel coding techniques including Huffman, Lampel-ziv, block codes, convolutional codes and decoding techniques, and automatic repeat request (ARQ) schemes.
3. Analyze the performance of coding techniques in communication and storage media.
4. Design practical coding and decoding techniques like RS, Turbo codes used in modern communication.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1, PO2, PO3, PO4 /PSO1, PSO2

MECE0003: APPLICATION SPECIFIC INTEGRATED CIRCUITS

Objectives: The course focuses on the semi-custom IC Design and introduces the principles of design logic cells, I/O cells and interconnects architecture, with equal importance given to FPGA and ASIC styles.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to ASICS, CMOS Logic and Library Design**: Types of ASICs, Design flow, CMOS transistors, CMOS Design rules, Combinational Logic Cell, Sequential logic cell, Data path logic cell, Transistors as Resistors, Transistor Parasitic Capacitance, Logical effort Library cell design, Library architecture . **Programmable ASICS, Logic Cell and I/Os:** Antifuse static RAM, EPROM and EEPROM technology, PREP benchmarks, Actel ACT, Xilinx LCA, Altera FLEX, Altera MAX DC & AC inputs and outputs - Clock & Power inputs, Xilinx LCA, Xilinx EPLD, Altera MAX 5000 and 7000, Altera MAX 9000, Altera FLEX .	21
II	**Logic Synthesis, Simulation and Testing** Design systems, Logic Synthesis, Half gate ASIC, Schematic entry, Low level design language, PLA tools -EDIF- CFI design representation. Verilog and logic synthesis, VHDL and logic synthesis, types of simulation, boundary scan test fault simulation, automatic test pattern generation. **ASIC Construction, Floor Planning, Placement and Routing** System partition, FPGA partitioning, partitioning methods, floor planning, placement, physical Design flow, global routing, detailed routing, special routing, and circuit extraction.	21

Text books:

- M.J.S. Smith, Application Specific Integrated Circuits, Addison -Wesley Longman Inc.1997.
- Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003.

Reference Books:

- Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.
- NekoogarF.. Timing Verification of Application-Specific Integrated Circuits (ASICs). Prentice Hall PTR, 1999.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the design flow of different types of ASIC.
2. Apply the types of programming technologies and logic devices.
3. Implement design steps like partitioning, floor planning, placement and routing including circuit extraction of ASIC
4. Analyse the synthesis, Simulation and testing of systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECC0004: OPTIMAL CONTROL SYSTEM

Objectives:

- To have complete familiarity with Calculus of Variation.
- To understand different forms of performance measures as applied to variety of optimal control problems.
- To model linear quadratic regulator problem.
- To understand Pontryagin's minimum principle.
- To apply dynamic programming.
- To motivate students towards research work on the subject.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**OPTIMAL CONTROL PROBLEMS:** Statement of optimal control problem - Problem formulation and types of optimal control - Selection of performance measures, General Model of feedback control systems, Transient performance analysis, Tracking performance analysis, Disturbance rejection analysis, Cost functions and norms, Mathematical preliminary to optimal control. **CALCULUS OF VARIATION AND HAMILTON FORMULATION:** Fundamental concepts - Extremum functionals involving single and several independent functions – Piecewise smooth extremals - Variation of functionals with fixed and free terminal time constrained extrema Pontryagin's minimum principle - State inequality constraints - The Weierstrass Erdmann corner conditions - Solution of Bolza problem. Partial differential equation for cost function - Hamilton Jacobi equation - Principle of optimality, solution of Hamilton Jacobi equation - Matrix Riccati equation - Optimal control law. **LINEAR QUADRATIC CONTROL PROBLEMS:** Optimal control by Liapunov method - Parameter optimization – Quadratic performance index - Optimal control of systems - Matrix Riccati equation and solution methods of State regulator and discrete systems - Choice of weighting matrices – Linear Quadratic Guassian control – Kalman filter – H_2 and $H\infty$ Control and Optimal estimation.	24
II	**DYNAMIC PROGRAMMING:** Principle of optimality - Recurrence relation of dynamic programming for optimal control problem - Combinational procedure for solving optimal control problem. **DISCRETE TIME SYSTEMS:** Solution of general discrete optimization problem - Discrete time linear quadratic regulator - Suboptimal feedback - Regulator problem with functions of final state fixed. Time optimal and fuel optimal control problems - Minimum time control problem, Uniqueness of control - Bang bang control – Case study-Aero space applications-Fuel optimal systems.	21

Text Books:

- Kirk D E, "Optimal Control Theory: An Introduction", Prentice Hall, New Jersey, 2008.
- Brian D O Anderson and John B Moore, "Optimal Control - Linear Quadratic Methods", Prentice Hall of India, 1991.

Reference Books:

- Jeffrey B Burl, “Linear Optimal Control”, Addison-Wesley, California, 1999.
- Frank L Lewis, “Optimal Control”, John Wiley & Sons, New York, 1986.
- Gopal M, “Modern Control System Theory”, Wiley Eastern, New Delhi, second Edition, 1993.
- Michael Athens. “Optimal Control”, Tata McGraw Hill Publishing Company Ltd., 1996.

Course Outcomes: After successfully completing the course students will be able to

1. Apply knowledge of advanced principles to the analysis of electrical and computer engineering problems.
2. Apply the appropriate industry practices, emerging technologies, state-of- the-art design techniques, software tools, and research methods in the field optimal control.
3. Model the LQR problem.
4. Design the optimal controller.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0005: DIGITAL SATELLITE COMMUNICATION

Objectives: To introduce various aspects in the design of systems for satellite communication.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Communication Satellite**: Elements of satellite communication, orbit period & velocity, Effects of orbit inclination, Azimuth & elevation, Coverage angle & Slant range, Eclipse, Placement of satellite in geostationary orbit, Communication subsystem, Telemetry command & ranging subsystem, Attitude control subsystem, Electrical power subsystem. **Earth Station** : Earth station, Antenna ,Antenna types, Antenna gain, Antenna pointing loss, Effective isotopic radiated power, Antenna gain to noise temperature ratio, G/T measurement ,High power amplifier, Redundancy configurations, Carrier combining, Power combining, Low noise amplifier: Redundancy configurations, Nonlinearity, Up converter & down converter, Conversion process, Transponder hopping, Polarization hopping, **Satellite Link** : Basic link analysis, Interference analysis: Carrier to noise plus interference ratio, Cross polarization interference ,Adjacent channel interference, Intermodulation interference ,Intersymbol interference ,Rain induced attenuation, Prediction of attenuation. **Frequency Division Multiple Access** : FDM-FM-FDMA, Single channel per carrier, FM-FDMA television, Companded FDM-FM-FDMA & SSB-AM-FDMA, Intermodulation products resulting from both amplitude & phase nonlinearities, Optimized carrier to intermodulation plus noise ratio.	22
II	**Time Division Multiple Access:** TDMA frame structure, Reference burst, Traffic burst, Guard time, TDMA burst structure, Unique word, Signaling channel, Traffic data, TDMA frame efficiency, Frame acquisition and Synchronization, Satellite position determination **Demand assigned Multiple Access:** The Erlang B formula, Types of demand assignments ,DAMA characteristics, Real-time frame reconfiguration, Frame and burst structures for DA-TDMA,DAMA interfaces,SCPC-DAMA,SPADE,Digital speech interpolation. **Satellite Packet Communications:**Message transmission by FDMA, The M/G/1 queue, pure ALOHA, Satellite packet switching, Slotted ALOHA, Packet reservation, Tree algorithm. **Satellite Spread Spectrum Communications**: Direct sequence spread spectrum systems,PN sequence, Error rate performance in uniform jamming, Error rate performance in pulsed jamming, , Frequency hop spread spectrum systems, DS acquisition and synchronization,FH acquisition and synchronization, Satellite on-board processing **Very Small Aperture Networks :**VSAT technologies, Network configurations multi-access and networking, **Mobile satellite networks**: operating environment, MSAT network concept, CDMA MSAT network concept, statistics of mobile propagation	22

Text book:

- Tri T. Ha. "Digital Satellite Communications" Tata-McGraw-Hill.1990.

References:

- Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt "Satellite Communications" 2nd Ed. John Wiley & Sons.
- Dennis Roddy "Satellite Communications" 3rd Ed. Mc-Graw-Hill.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the elements of satellite & earth station of satellite communication.
2. Understand the orbital mechanics, multiple access techniques like FDMA, TDMA & CDMA, Packet Communication & spread spectrum communication
3. Explain the working of Very Small Aperture Terminals (VSAT), Mobile satellite networks
4. Design a satellite link.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0006 : ADVANCED DATA NETWORK

Objectives:

- To learn most prevalent IPv6 addressing & its issues.
- To know various neighbor finding algorithms used for data routing.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**An Overview-** Fast access technologies (ADSL, Cable Modem etc.) **IPv6-** Why IPv6.Protocol architecture, Address Architecture, Internet Control Message Protocol for IPv6. **Neighbor Discovery-** Conceptual model of host, Service from neighbor Discovery Protocol, Message Formats, options	21
II	**Address Auto Configuration-** Stateless and State-full Auto Configurations, Duplicate Address Detection (DAD), Opti- DAD, DHCPv6, Interconnection between IPv6 and IPv4. **Domain Name system- terminology,** DNS Architecture, Domain Name space, name Resolution, Packet Format, DNS extension, Requirement for DNS support in transition. Mobility support in IPv6, Enhanced handover Schemes for Mobile IPv6, Enhanced Handover Schemes for mobile IPv6, Security in Mobile IP	21

Reference Books:

- "*Understanding IPv6*", YoungsongMun, Hyewon k, Lee, Springer.

Course Outcomes: After successfully completing the course students will be able to

1. Acquired knowledge about several sub-protocols behind IPv6.
2. Learn algorithms based on neighbor finding for shortest & Congestion free route.
3. Got an overview about Domain Name System (DNS).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0007: SPEECH PROCESSING

Objectives:

- To provide the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
- To describe basic algorithms of speech analysis common to many applications.
- To give an overview of applications (recognition, synthesis, coding).

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Digital Models for the Speech Signal:** Process of speech production, Acoustic theory of speech production, Lossless tube models, and Digital models for speech signals **Time Domain Models For Speech Processing:** Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using energy & zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing. **Digital Representations of the Speech Waveform:** Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, direct digital code conversion.	22
II	**Homomorphic Speech Processing:** Homomorphic systems for convolution, Complex cepstrum, Pitch detection, Formant estimation, Homomorphic vocoder. **Linear Predictive Coding of Speech:** Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Synthesis of speech from linear predictive parameters, Applications. **Speech Enhancement:** Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, Adaptive noise cancellation. **Speech Synthesis:** Principles of speech synthesis, Synthesizer methods, Synthesis of intonation, Speech synthesis for different speakers, Speech synthesis in other languages, Evaluation, Practical speech synthesis.	22

Text Book:

L. R. Rabiner and R. W. Schafer, “Digital Processing of Speech Signals”, Pearson Education (Asia) Pte. Ltd., 2004.

Reference Books:

- D. O’Shaughnessy, “Speech Communications: Human and Machine”, Universities Press, 2001.
- L. R. Rabiner and B. Juang, “Fundamentals of Speech Recognition”, Pearson Education (Asia) Pte. Ltd., 2004.

- Z. Li and M.S. Drew, "Fundamentals of Multimedia", Pearson Education (Asia) Pte. Ltd., 2004.

Course Outcomes: After successfully completing the course students will be able to

1. Demonstrate the representation of the speech signals in time and discrete domain.
2. Apply the speech processing algorithm to enhance the quality of speech
3. Analyze the algorithm to recognize and synthesize the speech of speaker.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0008: CMOS RF INTEGRATED CIRCUITS

Objectives: To provide students with RF circuit fundamentals for designing key building blocks in a typical RF transceiver using CMOS technology.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Parallel and Series RLC Resonant Networks, Impedance matching and Maximum power transfer, L Match-Low pass and High pass , T and Pi-match networks, RF Concepts: Non-linearity, Time variant, Harmonics, Gain Compression, Desensitization and Blocking, Cross-modulation, Intermodulation, Two tone test, Noise in RF circuits, Noise figure, Cascaded noise Figure, Transmitter –Cartesian and Polar Representation, Homodyne and Heterodyne architecture, Transmitter design issues: PA Pulling, Emission mask, Adjacent Channel Power, Spurs, noise	21
II	Direct conversion Receiver, Issues-DC offset, LO Self mixing, Interference leakage, 1/f noise, LO Pulling, Even order distortion I/Q mismatch, Heterodyne Receiver, IF frequency selection, Tradeoffs, Issues-Image Problem, Half IF problem, Dual IF Topology, Image Reject Receivers-Hartley and Weaver Architectures, Low noise amplifier (LNA), LNA Topologies, Mixers, Two-port and Three port mixers, Gilbert Mixer, Sources of non-linearity and noise in Gilbert Mixers, , Oscillators , RC and LC oscillators , Cross-coupled LC Oscillators ,Power Amplifiers-Linear and Switching type Power Amplifiers	22

Text Books:

- RF Microelectronics by BehzadRazavi. Pearson, 2012.

Reference Books:

- The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2006.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the basic principle of RF design and its tradeoff.
2. Analyze the performance parameters of radio frequency circuits.
3. Classify different typical transceiver architectures.
4. Design typical blocks of RF transceivers, including standard matching circuits, low-noise amplifiers, mixers, power amplifiers and RF oscillators.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0009: OPTOELECTRONIC DEVICES

Objectives:

- Describe fundamental and applied aspects of optoelectronic device physics and its applications to the design and operation of optical waveguide and electro optic modulators.
- Analyze optoelectronic device characteristics in detail using concepts from quantum mechanics and solid-state physics.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Optical wave guides** Integrated optic – Substrate materials for optical integrated circuits – Optical wave, guide modes – theory of planer wave guides – symmetric and symmetric slab wave guides – channel waveguides – strip loaded waveguides – losses in optical waveguides. Transverse couplers – prism couplers – Grating Tapered couplers – Fiber to waveguides couplers. **Electro optic modulators** Characteristics of switches and modulators – Electro optic effect – Single and dual channel wave guides – electro – optic modulator – Mach Zehnder type electro – optic modulator – Comparison of waveguides modulators.	21
II	**Acousto – Optic Modulator** Principle of acousto – optic effect – Raman – Nath type modulator – Bragg type deflectors and switches acousto – optic frequency shifters. **Magneto Optic Devices** Characteristics of magneto Optic effect – Non – reciprocal waveguides – Interaction between magnetic spin wave and Optic wave – Optical isolator – Optical isolator – Optical filter. **Non Linear Fiber Optics and Applications** Fiber non linar ties – Optical solutions – Non linear birefringence effects – Optical pulse compression – RF spectrum analyzer – Analog to digital converter – integrated optic Doppler velcimeterOpto electronic integrated circuits – Opto microwave applications.	22

Text books:

- R. G. hullsperger. Integrated Optics : Theory and Technology springer, verlag series, 1991.
- G. P. Agarwal, Non linear Optics, Academic Press, 1989.

Reference Books:

- J.wilson& J.F.B. Hawkes, Optoelectronics : An introduction Prentice hall Inter nations
- series, 1983.
- L. J. Pinsion. Electro optics, John Willy & sons, 1085.
- L. Sharupic. N. Tugliv, Optoelectronics, MIR Publicashers. 1987.

Course Outcomes: After successfully completing the course students will be able to

1. An understanding of state-of- the art optoelectronic technology.
2. Understand fundamental properties of light and operation principles of basic optical components.
3. An understanding of semiconductor material properties and semiconductor opto-electronic device physics.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO1, PSO2

MECE0010: VLSI TESTING & TESTABILITY

Objectives: This course covers introduction to the concepts and techniques of VLSI verification and testing. Details of test economy, fault modeling and simulation, defects, Automatic Test Pattern Generation (ATPG), design for testability and built-in self-test (BIST) also covered.

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Fault modeling and simulation:** Physical Faults and their modeling; Stuck at Faults, Bridging Faults, Fault detection, Fault Equivalence, Fault Dominance, Fault Collapsing and Checkpoint Theorem; General fault simulation techniques serial, parallel, concurrent and deductive fault simulation, critical path tracing, statistical fault analysis. **Combinational Circuit Test Pattern Generation:** Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras ,ATPG for single stuck-at faults and multiple stuck-at faults **Sequential Circuit Testing and Scan Chains:** ATPG for Single-Clock Synchronous Circuits, Use of Nine-Valued Logic and Time-Frame Expansion Methods, Complexity of Sequential ATPG	22
II	**Scan Chain based Sequential Circuit Testing** Scan Cell Design, Design variations of Scan Chains, Sequential Testing based on Scan Chains, Overheads of Scan Design, Partial-Scan Design **Design for testability:** Ad-hoc design for testability- test points, oscillators and clocks, logical redundancy; Controllability and observability, boundary scan partial/ full scan, serial and non-serial scan; boundary scan standard; Compression techniques; **Memory BIST** March Test, BIST with MISR, Neighborhood Pattern Sensitive Fault Test, Transparent Memory BIST	21

Text book:

- Abramovici, M., Breuer, M. A. and Friedman, "*A. D. Digital Systems Testing And Testable Design*". IEEE press (Indian edition available through Jayco Publishing house), 2001.

Reference Books:

- Abramovici, M., Breuer, M. A. and Friedman, "*A. D. Digital Systems Testing And Testable Design*". IEEE press (Indian edition available through Jayco Publishing house), 2001.
- Bushnell and Agarwal, "*V. D. VLSI Testing*", Kluwer.
- Agarwal, V. D. and Seth, S. C. "*Test Generation For VLSI Chips*". IEEE computer society press.
- Hurst, S. L. "*VLSI Testing: Digital And Mixed Analog/Digital Techniques*". INSPEC/IEE, 1999.

Outcomes:

1. Identify the significance of testable design.
2. Understand the concept of yield and identify the parameters influencing the same.
3. Specify fabrication defects, errors and faults.
4. Implement combinational and sequential circuit test generation algorithms.
   Identify techniques to improve fault coverage.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0011: BIOMEDICAL SIGNAL PROCESSING

Objectives: Objective of this course is to make students familiar with different types of biomedical signals and their analysis.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Discrete and continuous Random variables, Probability distribution and density functions. Gaussian and Rayleigh density functions, Correlation between random variables. Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth, noise figure of systems. Data Compression Techniques: Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Hoffman coding, vector quantisation, DCT and the K L transform.	22
II	Cardiological Signal Processing: Pre-processing. QRS Detection Methods. Rhythm analysis. Arrhythmia etection Algorithms. Automated ECG Analysis. ECG Pattern Recognition. Heart rate variability analysis. Adaptive Noise Canceling: Principles of Adaptive Noise Canceling. Adaptive Noise Canceling with the LMS daptation Algorithm. Noise Canceling Method to Enhance ECG Monitoring. Fetal ECG Monitoring. Neurological Signal Processing: Modeling of EEG Signals. Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive(A.R.) modeling of seizure EEG. Sleep Stage analysis. Inverse Filtering. Least squares and polynomial modeling.	22

Text Book:

D.C.Reddy, Biomedical Signal Processing- principles and techniques, Tata McGraw-Hill, 2005

Reference Books:

- Biomedical Digital Signal Processing, Willis J.Tompkins, PHI,
- Rangaraj M. Rangayyan – Biomedical Signal Analysis. IEEE Press, 2001.

Course Outcomes: After successfully completing the course students will be able to

CO1: Understand techniques for various levels of processes in biomedical signal analysis.
CO2: Demonstrate appropriate algorithms according to nature of the signal and acquisition characteristics.
CO3: Apply biomedical signal processing algorithms using appropriate tools like MATLAB.

CO4: Develop contemporary algorithms to address complex problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0012: WIRELESS COMMUNICATION & NETWORKS

Objectives: To study about Wireless networks, protocol stack and standards, study about fundamentals of 3G Services, its protocols and applications and study about evolution of 4G Networks, its architecture and applications

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Overview of wireless Communications** -Roadmap of cellular communications, first, second ,third& fourth generations, satellite communications, mobile cellular networks, circuit/packet switching, roadmap for wireless networking, wireless Local area networks, wireless personal area networks, wireless metropolitan area networks, wireless regional area networks, adhoc wireless networks, open system interconnect (OSI) reference. **Channel & Propagation-** Propagation loss ,free space loss, planet earth loss model, Okumura-Hata model,COST-231-Hata model,COST-231-Walfisch-Ikegami model ,Indoor propagation models, Channel fading, Log-normal shadowing ,Rayleigh fading, Random frequency modulation, Ricean fading, Nakagami fading, Doppler fading, WSSUS model ,Propagation mechanisms, reflection, refraction , scattering, diffraction, atmospheric effects, troposheric effects, ionospheric effects, Channel sounding. **Cellular & Multiple user systems-**The cellular concept, cell panning, cell capacity, interference, power control, channel assignment, handoff, duplexing, FDD,TDD, multiple access, FDMA, TDMA.CDMA, OFDMA, SDMA, random multiple access, ALOHA, carrier sense multiple access, scheduling access, Erlang capacity in uplink, protocol design for wireless networks, layered protocol design, cross layer design.	22
II	**Diversity-**Diversity methods, combining multiple signals, selection diversity, maximum ratio combining, equal gain combining, switch diversity, optimum combining, transmit diversity, open loop & closed loop transmit diversity, multiuser diversity. **Channel Estimation & Equalization**-Channel estimation, adaptive & blind channel estimation, channel equalization, optimum sequence detection, linear equalizer, decision feedback equalizer, MLSE equalizer, Veterbi algorithm, frequency domain equalizer, blind equalizer, pre-coding. **Spread Spectrum Modulation-**Introduction, spreading sequences, gold sequences , Kasami sequences ,Walsh sequences, orthogonal variable spreading factor sequences barker sequences, complementary codes, direct sequence spread spectrum .DS-CDMA model ,conventional receiver ,Rake receiver ,synchronization in CDMA, power control ,soft handoff, multiuser detection ,serial/parallel interference cancellation, combination of linear MUD & nonlinear SIC,BER performance, uplink capacity, frequency-hopping spread spectrum ,error performance of FHSS,FHSS versus DSSS.	22

Text books:

- "*Wireless Communication Systems"* from RF subsystems to 4G enabling technologies by Ke-Lin Du &M.N.Swamy, Cambridge University press, 2010.
- "*Wireless Communication*", principles & practices, second edition by theodoreS.Rappaport, Prentice Hall of India.

Reference Books:

- "*Wireless Communication Systems"* from RF subsystems to 4G enabling technologies by Ke-Lin Du &M.N.Swamy, Cambridge University press, 2010.
- "*Wireless Communication*", principles & practices, second edition by theodoreS.Rappaport, Prentice Hall of India.
- "*Modern Wireless Communications"* by Simon Haykin& Michael Moher, Pearson education,2005.
- "*Wireless Communication*" by Andrea Goldsmith, Cambridge University press, 2005.
- "*Fundamentals of Wireless Communicatio"n*, *David TSE* and PramodViswanath, Cambridge University Press, 2005.

Course Outcomes: After successfully completing the course students will be able to

1. Conversant with the latest 3G/4G and Wi-MAX networks and its architecture.
2. Design and implement wireless network environment for any application using latest wireless protocols and standards.
3. Implement different type of applications for smart phones and mobile devices with latest network strategies.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0013: CAD FOR VLSI CIRCUITS

Objectives:

- The design of all VLSI circuits is carried out by making extensive use Computer Aided Design (CAD) VLSI design tool.
- As part of the present introductory course the principles of operation of all the important modules that go into the construction of a complete VLSI CAD tool will be discussed.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**VLSI DESIGN METHODOLOGIES** Introduction to VLSI Design methodologies - Review of Data structures and algorithms - Review of VLSI Design automation tools - Algorithmic Graph Theory and Computational Complexity - Tractable and Intractable problems - general purpose methods for combinatorial optimization. **DESIGN RULES** Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning - Circuit representation - Placement algorithms - partitioning	21
II	**FLOOR PLANNING** Floor planning concepts - shape functions and floorplan sizing - Types of local routing problems -Area routing - channel routing - global routing - algorithms for global routing. **SIMULATION** Simulation - Gate-level modeling and simulation - Switch-level modeling and simulation -Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis. **MODELLING AND SYNTHESIS** High level Synthesis - Hardware models - Internal representation - Allocation assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.	21

Text books:

- S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

Reference Books:

- N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic
  Publishers, 2002.

Course Outcomes: After successfully completing the course students will be able to

1. Use VLSI design automation tools.
2. Perform high-level synthesis.
3. Discuss floor-planning concepts.
4. Design algorithms for placement and partitioning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO2	PO1, PO2, PO3, PO4 /PSO1, PSO2
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3

MECE0014: MEMORY DESIGN AND TESTING

Objectives:

- Get complete knowledge regarding different types of memories and their architectural techniques of memories.
- Analyze different parameters that lead malfunctioning of memories.
- Design reliable memories with efficient architecture to improve processes times and power.
- Design memory circuits with low power dissipation.

L–T–P: 4–0–0

Credits: 04

Module No:	Content	Teaching Hours
I	Introduction to SRAM, SRAM Architecture, SRAM Design Issues and Challenges, SRAM Bit-cell Topologies, Design Metrics of SRAM Bit-cell, Standard 6T SRAM Bit-cell: An Overview, Other SRAM Bit-cell Stability Metrics, Bit-line Measurement Design Metrics, Dynamic Stability Analysis, Single-Ended SRAM Bit-cell Design, Single-Ended 6T SRAM (SE-SRAM) Bit-cell, Read Stability and Write Ability Margins, Performance and Power Dissipation,2-Port SRAM Bit-cell Design, 2-Port 6T SRAM Bit-cell, Reconfigured Read-Port of a 2-Port 6T Bit-cell, SRAM Process Variation Sensitivity,	23
II	SRAM Bitcell Design Using Unidirectional Devices. Tunneling Transistors Development of TFETs Behavioural Model, NBTI and Its Effect on SRAM, The Physics of Negative Bias Temperature Instability NBTI Model SRAM Bitcells Under NBTI Effect of NBTI Under Process Variation Dynamic Random Access Memories (DRAMs):DRAM Technology Development-CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Strucutures-BiCMOS DRAMs-Soft Error Failures in DRAMs-Advanced DRAM Designs and Architecture-Application Specific DRAMs. Memory Fault Modeling, Testing, And Memory Design For Testability And Fault Tolerance RAM Fault Modeling, Electrical Testing, Peusdo Random Testing-Megabit DRAM Testing-Nonvolatile Memory Modeling and Testing-IDDQ Fault Modeling and Testing-Application Specific Memory Testing.	22

Text/ References books:

- Jawar Singh, Saraju P. Mohanty, Dhiraj K. Pradhan“Robust SRAM Designs and Analysis”by, ISBN 978-1-4614-0817-8, Springer New York Heidelberg Dordrecht London
- A.K Sharma, “ Semiconductor Memories Technology, Testing and Reliability”, IEEE Press.**:**
- Luecke Mize Care, “ Semiconductor Memory design & application”, Mc-Graw Hill.

Course Outcomes: After successfully completing the course students will be able to

1. Analysis the different types of RAM, ROM designs.
2. Analysis the different RAM and ROM architecture and interconnects.
3. Analysis about design and characterization technique.
4. Analysis of different memory testing and design for testability.
5. Identification of new developments in semiconductor memory design.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO2	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO3	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO4	PO1, PO2, PO3, PO4 /PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO2, PSO3

COURSES

(w.e.f. Session 2020-21)

PhD

(FULL TIME/PART TIME)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

INSTITUTE OF ENGINEERING & TECHNOLOGY

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	PECE0001	Adaptive Signal Processing	4	0	0	4
2.	PECE0002	Communication Techniques	4	0	0	4
3.	PECE0003	CMOS Analog IC Design	4	0	0	4
4.	PECE0004	Digital Hardware Design	4	0	0	4
5.	PECE0005	Image Processing	4	0	0	4
6.	PECE0006	Low Power VLSI Design	4	0	0	4
7.	PECE1007	Intelligent Systems and Control	4	0	0	4
8.	PECE0008	RF and Microwave Techniques	4	0	0	4
9	PECE0009	Embedded Systems	4	0	0	4
10	PECE0010	Information Theory and Coding	4	0	0	4
11	PECE0011	Application Specific Integrated Circuits	4	0	0	4
12	PECE0012	Wireless Communication and Networks	4	0	0	4
13	PECE0013	Digital Satellite Communication	4	0	0	4
14	PECE0014	Advanced Data Network	4	0	0	4
15	PECE0015	Speech Processing	4	0	0	4
16	PECE0016	CMOS RF Integrated Circuits	4	0	0	4
17	PECE0017	Optoelectronic Devices	4	0	0	4
18	PECE0018	VLSI Testing and Testability	4	0	0	4
19	PECE0019	Biomedical Signal Processing	4	0	0	4
20	PECE0020	Optimal Control System	4	0	0	4
21	PECE0021	CAD for VLSI Circuits	4	0	0	4

22	PECE0022	Evolution of Air Interface towards 5G	4	0	0	4
23	PECE0023	Principles of Signal Estimation for MIMO OFDM Wireless Communication	4	0	0	4
24	PECE0024	Deep Learning	4	0	0	4
24	PECE0025	Deep Learning for Computer Vision	4	0	0	4
25	PECE0026	Memory Design and Testing	4	0	0	4

PECE0001: ADAPTIVE SIGNAL PROCESSING

Objectives: To bring out the concepts related to stationary and non-stationary random signals to emphasize the importance of true estimation of power spectral density & introduce the design of linear and adaptive systems for filtering and linear prediction.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Basic Concepts of signal processing, IIR & FIR Filters, Random variables, Random Processes, Filtered Random Process, Correlation, Co variance, Power spectrum, Cross Power Spectrum, Ergodicity, Time Averages and estimators **Linear Prediction:** Direct form linear prediction filtering, normal equations for linear prediction filtering, Levinson algorithm, Linear prediction lattice filtering,	20
II	**Digital Wiener Filtering:** Wiener smoothing prediction filter, Application of Weiner smoothing to noise cancelling. **LMS adaptive Filters:** LMS adaptive algorithm, Properties of LMS adaptive filters. **LS Adaptive Filters:** Godard algorithm, lattice **Blind Adaptive Filtering Techniques:** Cost Function, Higher Order Statistics & examples	20

Text book:

- S. Haykin "*Adaptive Filter theory*", Prentice Hall, 4th Edition, 2001

Reference Books:

- "Adaptive filters, Theory and Application" B. Farhang-Boroujeny.
- Ali H. Sayed "*Fundamentals of Adaptive Filtering*", John- Willey Publication, 2003.
- A. Papoulis, S. U. Pillai "*Probability, Random Variables And Stochastic Process*" TMH publication.

Focus: This course focuses on employability aligned with CO3, CO4 and CO5.

Outcomes:

CO 1: Understand the parametric methods for power spectrum estimation.
CO 2: Demonstrate the stochastic signals in the vector space and linear prediction techniques.
Co 3: Apply the adaptive filtering techniques using LMS algorithm and the applications of adaptive filters.
CO 4: Design adaptive filters applying Different LMS Algorithms
CO5: Analyze performance of LMS and RLS algorithm.

PECE0002: COMMUNICATION TECHNIQUES

Credits: 04 **L–T–P: 4–0–0**

Course Objectives:

- To understand the different basic blocks of digital communication system.
- To design mathematical model of communication channels and digital signals.
- To analyze the signal flow in a digital communication system.
- To analyze the performance of digital communication in the presence of noise and interference.

Module No.	Content	Teaching Hours
I	**Introduction &**review of signals & systems: Elements of electrical communication system, communication channels & their characteristics, mathematical models for communication channels, frequency domain analysis of signals & systems: Fourier series & Fourier transform, power & energy, sampling of band limited signals, band pass signals. Random Theory: Probability & random variables, random processes, description of random processes, statistical averages, stationary processes, random processes & linear systems, random processes in frequency domain, power spectrum of stochastic processes, transmission over LTI systems, Gaussian & white processes, band limited processes and sampling, band pass processes. Digital transmission through additive white Gaussian noise channel-I : Geometric representation of signal waveforms, pulse amplitude modulation, two dimensional signal waveforms, baseband signals, two dimensional band pass signals-carrier phase modulation, two dimensional band pass signals-quadrature amplitude modulation, multidimensional signal waveforms, orthogonal, biorthogonal, simplex and binary coded, optimum receiver for digitally modulated signals in AWGN ,correlation type demodulator ,matched filter type demodulator, the optimum detector, demodulation & detection of carrier amplitude modulated signals, carrier phase modulated signals, quadrature amplitude modulated signals & frequency modulated signals	18
II	Digital transmission through additive white Gaussian noise Channel-I Probability of error for signal detection in AWGN, probability of error for binary modulation, M-ary PAM, phase coherent PSK modulation, DPSK, QAM, M-ary orthogonal signals, M-ary biorthogonal signals, M-ary simplex Signals and non-coherent detection of FSK, comparison of modulation methods**.** Digital transmission through Band Limited AWGN Channels : Digital PAM transmission through band limited baseband channels, Digital transmission through band limited band pass channels, power spectrum	22

	of the baseband signal & carrier modulated signal, Signal design for band limited channels, design of band limited signals for zero ISI-The Nyquist criterion and controlled ISI-partial response signals, probability of error for detection of digital PAM with zero ISI & symbol by symbol detection of data with controlled ISI, probability of error for detection of partial response signals, modulation codes & modulation signals with memory, the maximum-likelihood sequence detection of partial response signals, the power spectrum of digital signals with memory, system design in the presence of channel distortion, design of transmitting & receiving filters for a known channel, channel equalization.	

Text book:

- John G. Proakis and MasoudSalehi, "*Communication Systems Engineering*", Second Edition, Pearson Education.

Reference Books:

- B.P. Lathi and Zhi Ding, "*Modern Digital And Analog Communication Systems"*, International fourth edition, Oxford University Press.
- S. Haykins, "*Communication Systems",* 5th ed., John wiley.
- M. K. Simon, S. M. Hinedi and W. C. Lindsey, "*Digital Communication Techniques: Signaling And Detection",* Prentice Hall India, N. Delhi, 1995.
- A.Papoulis, S.U.Pillai, Probability, "*Random Variables And Stochastic Processes"*, Mc Graw Hill, fourth Edition.

Focus: This course focuses on employability aligned with CO3 and CO4.

Course Outcomes: After successful completion of the course students will be able to

1. Represent the digital signal in baseband and pass-band format.
2. Represent the digital signal in vector space.
3. Design the optimum receiver scheme for digital communication.
4. Analyze the performance of digital communication in presence of noise.

PECE0003: CMOS Analog IC Design

Objectives:

- To provide in-depth understanding of the analog integrated circuit and building blocks
- To provide a basic idea on mixed signal IC design

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	Introduction to CMOS ICs, Body effect , small and large signal behavior of basic amplifier circuits, MOSFET Capacitances, Gain-boosed and Folded Cascode circuits, Cascode - Cascode current mirrors, Introduction to noise Representation of noise in circuits Noise in common-source and cascode circuits, Introduction to negative feedback, Nyquist plots and stability criteria, Loop gain and stability	21
II	Single-stage opamp, Telescopic opamp, Folded-cascode opamp,Two-stage opamp, Fully-differential Opamps, Phase Detectors, PLL building blocks, Charge pump PLL and its limitations, Introduction to VCOs	22

Text books:

- Design of Analog CMOS Integrated Circuits by Behzad Razavi, TMH Edition.
- CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition, 2010.

Reference books:

- Design of Analog CMOS Integrated Circuits by Behzad Razavi, TMH Edition.
- CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition, 2010.
- Analysis and Design of Analog Integrated Circuits by Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.
- Analog Integrated Circuit Design by David A. Johns, Ken Martin, Wiley Student Edition, 2013.

Focus: This course focuses on employability aligned with CO3 and CO4.

Course Outcomes: After successfully completing the course students will be able to

CO1: Demonstrate the design step the CMOS Technology

CO2: Explain the various amplifier topology including cascade and cascode

CO3: Analyze the performance of analog circuits

CO4: Design the analog IC design problems including the single and stage amplifier , PLL

PECE0004 : DIGITAL HARDWARE DESIGN

Objectives: The Objective of the course is to provide deep understanding of the design methodologies for combinational, sequential digital systems, arithmetic and logic circuits, accumulator design, fault diagnosis, state finite machines and threshold logic design.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Review of basic building blocks of digital electronics, basic concepts. Analysis and design of typical combinational circuits, analysis and design of synchronous sequential circuits, design of arithmetic circuits, design of logic circuits, design of ALU; Accumulates design, status register, design of shifter, arithmetic and logic operation. Design of computer instructions, register transfer, bus and memory transfer, threshold logic hazards, reliable design and fault diagnosis	20
II	State equivalence and minimization of states, state assignment, state identification and fault detection experiments, asynchronous sequential circuits, races and hazards. Booth's Multiplier, control unit design methods, micro-programmed control, designed of a micro-programmed CPU, Realization with ROM, Main memory array design, auxiliary memory, memory hierarchy, associative memory, virtual memory and memory management concepts, cache memory organization, programmable logic devices, field programmable devices, hardware descriptive language.	20

Text books:

- "*Switching and Finite Automata Theory*" by Z. Kohavi, Tata McGraw-Hill, Second Edition
- "*Fundamentals of Switching Theory and Logic Design*" by Astola and Stankovic, Springer

Reference Books:

- "*Modern Computer Architecture*" by Rafiquzzaman and Chandra, Galgotia Publication.
- "*Computer System Architecture*", M. Morris Mano, PHI.
- Wayne Wolf, **Computers as Components; Principles of Embedded Computing System Design** – Harcourt India, Morgan Kaufman Publishers, First Indian Reprint 2001
- "*Frank Vahid and Tony Givargis*", **Embedded Systems Design – A unified Hardware /Software Introduction**, John Wiley, 2002.

Focus: This course focuses on employability aligned with CO3 and CO4.

Course Outcomes: After successfully completing the course students will be able to

1. Apply logic fundamentals in the design of memory.
2. Analyze and develop basic logic pipelined machines.

3. Design of state finite machines.
4. Synthesize working circuits using hardware design logic.

PECE0005: IMAGE PROCESSING

Objectives: This course enables the students.

- To define image sampling, quantization, pixels relationship, features, descriptors and classification
- To explain various intensity transformations, image segmentation, various feature extraction approaches, and different classifiers.
- To apply various basic preprocessing (noise reduction, enhancement etc.) and advanced (segmentation, restoration and classification etc.) image processing algorithms.

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	**Digital Image Fundamentals:** Introduction, Fundamental of image, Elements of an image processing system, Image sampling & quantization; Basic relationships between pixels, mathematical Preliminaries: Image transforms. **Image Enhancement:** Gary-Scale Transformation, Piecewise linear transformation, Bit Plane slicing, Histogram Equalization, Enhancement by arithmetic Operations, Smoothing and sharpening using filters, Image blur type and quality measure, image enhancement in frequency domain. **Image Segmentation:** Thresholding, Object labeling, Edge Operators, Edge Linking by Adaptive Mathematical Morphology, Automatic Seeded Region Growing, A Top-Down Region Dividing Approach.	20
II	**Image coding:** Introduction to image coding, Some coding techniques: Run length coding, Bit-plane coding, Sub-band coding. **Image Representation and Description:** Boundary Extraction, Contour Representation, Skeletonization by Thinning, Medial Axis Transformation, Object Representation and Tolerance **Feature Extraction:** Fourier Descriptor and Moment Invariants, Shape Number and Hierarchical Features, Corner Detection, Hough Transform, Principal Component Analysis, Linear Discriminate Analysis, Feature Reduction in Input and Feature Spaces. **Classifiers:** Bayes Classifier, Support Vector Machine, K-Nearest neighbor (KNN) in Image Analysis.	20

	Case Study: Face Recognition, Medical Image. Watermarking, Finger Prints. (Any **TWO** case studies to be undertaken by each student)	

Text books:

- Digital Image Processing, 3rd Edition, by R.C.Gonzalez and R.E.Woods, Prentice Hall
- Solomon, C and Breckon, T. "Fundamentals of Digital Image Processing: a Practical Approach with Examples in MATLAB. John Wiley and sons.
- Bhabatosh Chanda, D. Dutta Majumder (2011). "Digital Image Processing and Analysis", PHI.

References:

- Fundamentals of Digital Image Processing, by Anil K. Jain, Prentice-Hall, 1989
- Digital Image Processing: An Algorithmic Approach; by MA Joshi PHI 2006
- Image Processing and Pattern Recognition: Fundamentals and Techniques, by Frank Y. Shi, Wiley , IEEE

Focus: This course focuses on employability aligned with CO3 and CO4.

Outcomes: Upon successful completion of this course, students will be able to

1. Define basic terminology of digital image processing.
2. Demonstrate the methodologies for image segmentation, restoration etc.
3. Apply intensity transformations and spatial filtering.
4. Design image-processing algorithms in practical applications.

PECE0006: LOW POWER VLSI DESIGN

Objectives:

- Identify sources of power in an IC.
- Identify the power reduction techniques based on technology independent and technology dependent.
- Power dissipation mechanism in various MOS logic style.
- Identify suitable techniques to reduce the power dissipation.
- Design memory circuits with low power dissipation.

Credits: 04 **L–T–P: 4–0–0**

Module No:	Content	Teaching Hours
I	**Fundamentals:** Need for Low Power Circuit Design, Sources of Power Dissipation: Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation **Short Channel Effects:** Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Switched Capacitance and minimization approaches. **Low Power Design:** Voltage scaling, VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. **Adders Design:** Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders,	21
II	Low-Voltage Low-Power Design Techniques–Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles, **Low-Power Memories:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM, RAM fault modeling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing.	21

Text books:

- CMOS Digital Integrated Circuits by Analysis and Design by Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
- Low-Voltage, Low-Power VLSI Subsystems by Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

References:

- Introduction to VLSI Systems: A logic, Circuit and System Perspective by Ming-BOLIN, CRC Press, 2011.

- Low Power CMOS Design by Anantha Chandrakasan, IEEE Press/ Wiely International, 1998.
- Low Power CMOS VLSi Circuit Design by Kaushik Roy, Sharat C Prasad, John Wuiely& Sons, 2000.

Focus: This course focuses on employability aligned with CO2, CO3 and CO4.

Course Outcomes: After successfully completion of the Course, student will able to:

CO 1:- Explain the various types of power dissipation and short channel effects.

CO 2- Analyze the performance of architectural approaches and scaling of CMOS integrated circuits with reference to speed and power dissipation.

CO 3:- Apply the power minimization techniques to reduce the power dissipation.

PECE1007: INTELLIGENT SYSTEMS AND CONTROL

Course Objectives

- To provide students an opportunity to study the concepts of classical control design techniques like, P, PI and PID controllers.
- To provide students an opportunity to study the aspects of computational intelligence methods in depth to develop intelligent adaptive controllers.
- It focuses on designing intelligent controller using fuzzy logic, artificial neural networks and genetic algorithm techniques.
- It gives the analysis of learning systems in combination with feedback control systems, computer simulation of intelligent control systems to evaluate the performance.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Artificial Intelligence:** Introduction, Intelligence, Soft and Hard Computing, Artificial Intelligence. **Non-linear control:** Primer- Norms of signals, Vectors and matrices, Positive definite function, Positive definite matrices, Continuous time state model, Discrete time state space model, Lyapunov stability theory, Non Linear control strategies. **Genetic Algorithm**-Basic concept of Genetic algorithm and detail algorithm steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. **Fuzzy Logic:** Classical sets, Fuzzy sets, Fuzzy rule base and approximate reasoning, Fuzzy logic control, System identification using T-S fuzzy models.	21
II	**Neural Networks:** Feed forward Networks, Multi-layered neural network, Redial basis function networks, Recurrent neural networks, Chebyshev neural network, System identification using neural networks. **Indirect adaptive control using neural networks:** Continuous time affine systems, Discrete-time affine system, Discrete-time Non-affine system, **Direct Adaptive Control using neural Networks:** Direct adaptive control single-input–single-output affine systems, Single-input-single output discrete time affine systems, Backstepping control. Neural network control of nonlinear discrete-time systems with actuator nonlinearities.	21

Text book:

- L. Behera, I. Kar, “Intelligent Systems & Control,” Second Edition, Oxford University Press
- J. Stuart. Russell & Peter Norvig, “Artificial Intelligence: A Modern Approach,” 1st Edition, Prentice Hall
- Simon Haykin, “Neural Networks: A Comprehensive Foundation,” 2nd Edition, Prentice Hall

Reference Book:

- Jagannathan Sarangapani, “Neural Network Control of Nonlinear Discrete time Systems,” Taylor & Francis

Focus: This course focuses on employability aligned with CO2, CO3 and CO4.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the classical and fuzzy logic controllers for linear as well as nonlinear systems.
2. Apply the concept of meta-heuristic optimization algorithm like genetic algorithm for tuning of controller.
3. Analyze the stability and controllability of nonlinear systems.
4. Design an Artificial Neural Network for training and testing purpose of a system.

PECE0008: RF AND MICROWAVE TECHNIQUES

Objectives

To learn principles of the RF and microwave techniques, transmission line theory, Scattering parameters, design and analysis of commonly used passive and active components in RF and Microwave frequency range.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Transmission Lines (TL)**: Introduction, Terminations of TLs, TL input impedance, time average power, Return and insertion losses, Voltage Standing Wave Ratio, The Smith chart and its applications **Impedance Matching and Tuning:** Transmission Line matching with lumped *L* Networks, Stub tuning, Quarter-wave transformer matching **Microwave Network Analysis:** S parameters and the Scattering matrix, Properties of S matrices, S parameters and time average power **Passive Components:** Properties of dividers and couplers, T-Junction power divider, Wilkinson power divider, Quadrature (90^o) hybrid, The 180^o hybrid	21
II	**Microwave Filters:** Microwave Filter design by insertion loss method, Scaling of low pass prototype filters, Filter transformations **Microwave Amplifier Design**: Two-port power gains, Amplifier Stability, Single-stage transistor amplifier: Design for maximum gain, Design for specific gain. **Frequency Multipliers, Oscillators and Mixers:** Frequency multipliers, RF oscillators, Microwave oscillators, Oscillator phase noise, Mixers: Mixer characteristics, Single ended mixer, Balanced mixer	21

Text book:

- David M. Pozar, "*Microwave Engineering*", Third Edition, Wiley India.

Reference Books:

- Reinhold Ludwig & Gene Bogdanov, " RF circuit design: theory and applications", Prentice Hall, 2009
- Peter A. Rizzi, "*Microwave engineering: passive circuits, Prentice Hall*", 1988.
- Bharathi Bhat &Shiban K. Koul, "*Stripline-Like Transmission Lines For Microwave Integrated Circuits*", New Age International, 1989.

Focus: This course focuses on employability aligned with CO2, CO3 and CO4.

Course Outcomes: After successfully completing the course students will be able to

After successfully completing the course students will be able to

1. Understand S-parameters and network characterization techniques using S- parameters.
2. Analyze transmission line networks
3. Design Transmission Line matching with lumped *L* Networks, Stub tuning, Quarter-wave transformer matching
4. Design of commonly used passive components as microwave power dividers, directional couplers filers, microwave amplifiers, frequency multipliers, oscillators and mixers in RF and microwave frequencies

PECE0009: EMBEDDED SYSTEMS

Objectives: The course intends to develop an understanding of the technologies behind the embedded computing systems and also provide overview of various Microcontrollers, Real time operating system and advanced architectures like ARM processor.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Embedded Systems** Overview of Embedded Systems, Classification of Embedded Systems, Processor Embedded into a system, Embedded Hardware Units and Devices in system, Embedded Software, Design Process in Embedded System. **Overview of Microcontroller:** Microcontroller and Embedded Processors, Overview of 8051 Microcontroller family: Architecture, Input/output Ports and Circuits, External Memory, Counters and Timers. The program Counter and ROM Spaces in the 8051, Data types, 8051 Flag Bits ad PSW Register, 8051 Register Banks **8051 Assembly language programming** 8051-Instruction set, addressing modes, accessing memory using various addressing modes, Arithmetic instructions and programs, Logical instructions, BCD and ASCII application programs, Single-bit instruction programming, Reading input pins vs. port Latch, Programming of 8051 Timers, Counter Programming . Time delay generations and calculations. 8051 interrupts, Programming of timer interrupts, Programming of External hardware interrupts, Programming of the serial communication interrupts, interrupt priority in the 8051.	21
II	**Interfacing with 8051:** Interfacing an LCD to the 8051, 8051 interfacing to ADC, Sensors, Interfacing a Stepper Motor, 8051 interfacing to the keyboard, Interfacing a DAC to the 8051. **PIC Microcontroller** Introduction: PIC microcontroller features, PIC Architecture, Program memory, Addressing Modes, Instruction set, Instruction Format, Byte-Oriented Instructions, Bit-Oriented Instructions, Literal Instructions, Control Instructions	21

	Advanced Microcontrollers: Only brief general architecture of AVR, and ARM microcontrollers. **Design, Development and Debugging Tools for Microcontroller based Systems:** Software tools like Cross assembler, compiler, debuggers, simulators and hardware tools like In-Circuit Emulators(ICE), Emulators, Logic Analyzers etc.	

Text Books:

- Muhammad Ali Mazidi, Janice GillispieMazidi., "The 8051 Microcontroller and Embedded systems", Person Education, 2nd Edition, 2004.
- John.B.Peatman, "Design with Microcontrollers", Person Education, 1st Edition, 2004.

Reference Books:

- Ayala, Kenneth, "The 8051 Microcontroller", Thomson, 2nd Edition, 2000.
- David E. Simon, "An Embedded Software Primer", Pearson Education, 1999.
- V. Deshmukh, "Microcontrollers: theory and applications", Tata Mc Graw Hill, 12th reprint, 2005.

Focus: This course focuses on employable aligned with CO2 and CO3.

Course Outcomes: After successfully completing the course students will be able to

1. Understand embedded systems and the embedded system design process.
2. Apply the basic 8051 and PIC microcontrollers architecture and programming.
3. Design the various applications like blinking of LED Digital logic, Precision Analog and serial Communications.

PECE0010: INFORMATION THEORY & CODING

Objectives: The course aims at providing students a foundation in information theory – the theory that provides quantitative measures of information and allows us to analyze and characterize the fundamental limits of communication systems.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Information Theory :-**Concept of amount of information, entropy, marginal, conditional and joint entropies and relation among entropies mutual information, information rate, Source coding Kraft‘s inequality, coding efficiency and redundancy, Noiseless coding theorem **Construction of basic sourcecodes**: Shannon Fano Algorithm, Huffman coding, Channel capacity, redundancy and efficiency of a channel, binary symmetric channel (BSC), Binary error channel (BEC) capacity of band limited Gaussian channels, Shannon Hartley theorem, Bandwidth- SNR trade off, capacity of a channel of infinite bandwidth, Shannon‘s limit, Introduction to rings, fields, and Galois fields,	20
II	Codes for error detection and correction, parity check coding linear block codes error detecting and correcting capabilities generator and parity check matrices, standard array and syndrome decoding, perfect codes, Hamming codes encoding and decoding, cyclic codes polynomial and matrix descriptions generation of cyclic codes, decoding of cyclic codes, BCH codes description and decoding, Reed Solomon Codes, Burst error correction. Convolution Codes, Trellis diagrams, transfer function and minimum free distance, Maximum likelihood decoding of convolution code, the Viterbi algorithm, Sequential decoding, Cryptography, LDPC, Space time codes, Bar codes	22

Text book:

- R Bose, "Information Theory, Coding and Cryptography", TMH publication.

Reference Books:

- Das Mullick Chatterjee "Principles of Digital communication" Wiley Eastern Ltd.
- P.S. Sathya Narayana "Concepts of Information Theory & Coding "Dynaram Publications, 2005.

Focus: This course focuses on employable aligned with CO3 and CO4.

Outcomes:

1. Understand the basic notions of information and channel capacity.
2. Demonstrate different source and channel coding techniques including Huffman, Lampel-ziv, block codes, convolutional codes and decoding techniques, and automatic repeat request (ARQ) schemes.
3. Analyze the performance of coding techniques in communication and storage media.
4. Design practical coding and decoding techniques like RS, Turbo codes used in modern communication.

PECE0011: APPLICATION SPECIFIC INTEGRATED CIRCUITS

Objectives: The course focuses on the semi-custom IC Design and introduces the principles of design logic cells, I/O cells and interconnects architecture, with equal importance given to FPGA and ASIC styles.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to ASICS, CMOS Logic and Library Design**: Types of ASICs, Design flow, CMOS transistors, CMOS Design rules, Combinational Logic Cell, Sequential logic cell, Data path logic cell, Transistors as Resistors, Transistor Parasitic Capacitance, Logical effort Library cell design, Library architecture . **Programmable ASICS, Logic Cell and I/Os:** Antifuse static RAM, EPROM and EEPROM technology, PREP benchmarks, Actel ACT, Xilinx LCA, Altera FLEX, Altera MAX DC & AC inputs and outputs - Clock & Power inputs, Xilinx LCA, Xilinx EPLD, Altera MAX 5000 and 7000, Altera MAX 9000, Altera FLEX .	21
II	**Logic Synthesis, Simulation and Testing** Design systems, Logic Synthesis, Half gate ASIC, Schematic entry, Low level design language, PLA tools -EDIF- CFI design representation. Verilog and logic synthesis, VHDL and logic synthesis, types of simulation, boundary scan test fault simulation, automatic test pattern generation. **ASIC Construction, Floor Planning, Placement and Routing** System partition, FPGA partitioning, partitioning methods, floor planning, placement, physical Design flow, global routing, detailed routing, special routing, and circuit extraction.	21

Text books:

- M.J.S. Smith, Application Specific Integrated Circuits, Addison -Wesley Longman Inc.1997.
- Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003.

Reference Books:

- Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.
- NekoogarF.. Timing Verification of Application-Specific Integrated Circuits (ASICs). Prentice Hall PTR, 1999.

Focus: This course focuses on employable aligned with CO2, CO3 and CO4.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the design flow of different types of ASIC.
2. Apply the types of programming technologies and logic devices.
3. Implement design steps like partitioning, floor planning, placement and routing including circuit extraction of ASIC
4. Analyse the synthesis, Simulation and testing of systems.

PECE0012: WIRELESS COMMUNICATION & NETWORKS

Objectives: To study about Wireless networks, protocol stack and standards, study about fundamentals of 3G Services, its protocols and applications and study about evolution of 4G Networks, its architecture and applications

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Overview of wireless Communications** -Roadmap of cellular communications, first, second, third& fourth generations, satellite communications, mobile cellular networks, circuit/packet switching, roadmap for wireless networking, wireless Local area networks, wireless personal area networks, wireless metropolitan area networks, wireless regional area networks, adhoc wireless networks, open system interconnect (OSI) reference. **Channel & Propagation-** Propagation loss ,free space loss, planet earth loss model, Okumura-Hata model,COST-231-Hata model,COST-231-Walfisch-Ikegami model ,Indoor propagation models, Channel fading, Log-normal shadowing ,Rayleigh fading, Random frequency modulation, Ricean fading, Nakagami fading, Doppler fading, WSSUS model ,Propagation mechanisms, reflection, refraction , scattering, diffraction, atmospheric effects, troposheric effects, ionospheric effects, Channel sounding. **Cellular & Multiple user systems-**The cellular concept, cell panning, cell capacity, interference, power control, channel assignment, handoff, duplexing, FDD,TDD, multiple access, FDMA, TDMA.CDMA, OFDMA, SDMA, random multiple access, ALOHA, carrier sense multiple access, scheduling access, Erlang capacity in uplink, protocol design for wireless networks, layered protocol design, cross layer design.	22
II	**Diversity-**Diversity methods, combining multiple signals, selection diversity, maximum ratio combining, equal gain combining, switch diversity, optimum combining, transmit diversity, open loop & closed loop transmit diversity, multiuser diversity. **Channel Estimation & Equalization-**Channel estimation, adaptive & blind channel estimation, channel equalization, optimum sequence detection, linear equalizer, decision feedback equalizer, MLSE equalizer, Veterbi algorithm, frequency domain equalizer, blind equalizer, pre-coding. **Spread Spectrum Modulation-**Introduction, spreading sequences, gold sequences , Kasami sequences ,Walsh sequences, orthogonal variable spreading factor sequences barker sequences, complementary codes, direct sequence spread spectrum .DS-CDMA model ,conventional receiver ,Rake receiver ,synchronization in CDMA,	22

	power control ,soft handoff, multiuser detection ,serial/parallel interference cancellation, combination of linear MUD & nonlinear SIC,BER performance, uplink capacity, frequency-hopping spread spectrum ,error performance of FHSS,FHSS versus DSSS.	

Text books:

- "*Wireless Communication Systems"* from RF subsystems to 4G enabling technologies by Ke-Lin Du &M.N.Swamy, Cambridge University press, 2010.
- "*Wireless Communication*", principles & practices, second edition by theodoreS.Rappaport, Prentice Hall of India.

Reference Books:

- "*Wireless Communication Systems"* from RF subsystems to 4G enabling technologies by Ke-Lin Du &M.N.Swamy, Cambridge University press, 2010.
- "*Wireless Communication*", principles & practices, second edition by theodoreS.Rappaport, Prentice Hall of India.
- "*Modern Wireless Communications"* by Simon Haykin& Michael Moher, Pearson education,2005.
- "*Wireless Communication*" by Andrea Goldsmith, Cambridge University press, 2005.
- "*Fundamentals of Wireless Communicatio"n*, *David TSE* and PramodViswanath, Cambridge University Press, 2005.

Focus: This course focuses on employable aligned with CO2 and CO3.

Course Outcomes: After successfully completing the course students will be able to

1. Conversant with the latest 3G/4G and Wi-MAX networks and its architecture.
2. Design and implement wireless network environment for any application using latest wireless protocols and standards.
3. Implement different type of applications for smart phones and mobile devices with latest network strategies.

MECE0013: DIGITAL SATELLITE COMMUNICATION

Objectives: To introduce various aspects in the design of systems for satellite communication.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Communication Satellite**: Elements of satellite communication, orbit period & velocity, Effects of orbit inclination, Azimuth & elevation, Coverage angle & Slant range, Eclipse, Placement of satellite in geostationary orbit, Communication subsystem, Telemetry command & ranging subsystem, Attitude control subsystem, Electrical power subsystem. **Earth Station** : Earth station, Antenna ,Antenna types, Antenna gain, Antenna pointing loss, Effective isotopic radiated power, Antenna gain to noise temperature ratio, G/T measurement ,High power amplifier, Redundancy configurations, Carrier combining, Power combining, Low noise amplifier: Redundancy configurations, Nonlinearity, Up converter & down converter, Conversion process, Transponder hopping, Polarization hopping, **Satellite Link** : Basic link analysis, Interference analysis: Carrier to noise plus interference ratio, Cross polarization interference ,Adjacent channel interference, Intermodulation interference ,Intersymbol interference ,Rain induced attenuation, Prediction of attenuation. **Frequency Division Multiple Access** : FDM-FM-FDMA, Single channel per carrier, FM-FDMA television, Companded FDM-FM-FDMA & SSB-AM-FDMA, Intermodulation products resulting from both amplitude & phase nonlinearities, Optimized carrier to intermodulation plus noise ratio.	22
II	**Time Division Multiple Access:** TDMA frame structure, Reference burst, Traffic burst, Guard time, TDMA burst structure, Unique word, Signaling channel, Traffic data, TDMA frame efficiency, Frame acquisition and Synchronization, Satellite position determination **Demand assigned Multiple Access:** The Erlang B formula, Types of demand assignments ,DAMA characteristics, Real-time frame reconfiguration, Frame and burst structures for DA-TDMA,DAMA interfaces,SCPC-DAMA,SPADE,Digital speech interpolation. **Satellite Packet Communications:**Message transmission by FDMA, The M/G/1 queue, pure ALOHA, Satellite packet switching, Slotted ALOHA, Packet reservation, Tree algorithm. **Satellite Spread Spectrum Communications**: Direct sequence spread spectrum systems,PN sequence, Error rate performance in uniform jamming, Error rate performance in pulsed jamming, , Frequency hop	22

	spread spectrum systems, DS acquisition and synchronization,FH acquisition and synchronization, Satellite on-board processing **Very Small Aperture Networks :**VSAT technologies, Network configurations multi-access and networking, **Mobile satellite networks**: operating environment, MSAT network concept, CDMA MSAT network concept, statistics of mobile propagation	

Text book:

- Tri T. Ha. "Digital Satellite Communications" Tata-McGraw-Hill.1990.

References:

- Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt "Satellite Communications" 2nd Ed. John Wiley & Sons.
- Dennis Roddy "Satellite Communications" 3rd Ed. Mc-Graw-Hill.

Focus: This course focuses on employable aligned with CO3 and CO4.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the elements of satellite & earth station of satellite communication.
2. Understand the orbital mechanics, multiple access techniques like FDMA, TDMA & CDMA, Packet Communication & spread spectrum communication
3. Analyse the working of Very Small Aperture Terminals (VSAT), Mobile satellite networks
4. Design a satellite link.

PECE0014 : ADVANCED DATA NETWORK

Objectives:

- To learn most prevalent IPv6 addressing & its issues.
- To know various neighbor finding algorithms used for data routing.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**An Overview-** Fast access technologies (ADSL, Cable Modem etc.) **IPv6-** Why IPv6.Protocol architecture, Address Architecture, Internet Control Message Protocol for IPv6. **Neighbor Discovery-** Conceptual model of host, Service from neighbor Discovery Protocol, Message Formats, options	21
II	**Address Auto Configuration-** Stateless and State-full Auto Configurations, Duplicate Address Detection (DAD), Opti- DAD, DHCPv6, Interconnection between IPv6 and IPv4. **Domain Name system- terminology,** DNS Architecture, Domain Name space, name Resolution, Packet Format, DNS extension, Requirement for DNS support in transition. Mobility support in IPv6, Enhanced handover Schemes for Mobile IPv6, Enhanced Handover Schemes for mobile IPv6, Security in Mobile IP	21

Reference Books:

- "*Understanding IPv6*", YoungsongMun, Hyewon k, Lee, Springer.

Focus: This course focuses on employable aligned with CO2 and CO3.

Course Outcomes: After successfully completing the course students will be able to

1. Acquired knowledge about several sub-protocols behind IPv6.
2. Apply algorithms based on neighbor finding for shortest & Congestion free route.
3. Design Domain Name System (DNS).

PECE0015: SPEECH PROCESSING

Objectives:

- To provide the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
- To describe basic algorithms of speech analysis common to many applications.
- To give an overview of applications (recognition, synthesis, coding).

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Digital Models for the Speech Signal:** Process of speech production, Acoustic theory of speech production, Lossless tube models, and Digital models for speech signals **Time Domain Models For Speech Processing:** Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using energy & zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing. **Digital Representations of the Speech Waveform:** Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, direct digital code conversion.	22
II	**Homomorphic Speech Processing:** Homomorphic systems for convolution, Complex cepstrum, Pitch detection, Formant estimation, Homomorphic vocoder. **Linear Predictive Coding of Speech:** Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Synthesis of speech from linear predictive parameters, Applications. **Speech Enhancement:** Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, Adaptive noise cancellation. **Speech Synthesis:** Principles of speech synthesis, Synthesizer methods, Synthesis of intonation, Speech synthesis for different speakers, Speech synthesis in other languages, Evaluation, Practical speech synthesis.	22

Text Book:

L. R. Rabiner and R. W. Schafer, “Digital Processing of Speech Signals”, Pearson Education (Asia) Pte. Ltd., 2004.

Reference Books:

- D. O’Shaughnessy, “Speech Communications: Human and Machine”, Universities Press, 2001.
- L. R. Rabiner and B. Juang, “Fundamentals of Speech Recognition”, Pearson Education (Asia) Pte. Ltd., 2004.
- Z. Li and M.S. Drew, “Fundamentals of Multimedia”, Pearson Education (Asia) Pte. Ltd., 2004.

Focus: This course focuses on employable aligned with CO2 and CO3.

Course Outcomes: After successfully completing the course students will be able to

1. Demonstrate the representation of the speech signals in time and discrete domain.
2. Apply the speech processing algorithm to enhance the quality of speech
3. Analyze the algorithm to recognize and synthesize the speech of speaker.

PECE0016: CMOS RF INTEGRATED CIRCUITS

Objectives: To provide students with RF circuit fundamentals for designing key building blocks in a typical RF transceiver using CMOS technology.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Parallel and Series RLC Resonant Networks, Impedance matching and Maximum power transfer, L Match-Low pass and High pass , T and Pi-match networks, RF Concepts: Non-linearity, Time variant, Harmonics, Gain Compression, Desensitization and Blocking, Cross-modulation, Intermodulation, Two tone test, Noise in RF circuits, Noise figure, Cascaded noise Figure, Transmitter –Cartesian and Polar Representation, Homodyne and Heterodyne architecture, Transmitter design issues: PA Pulling, Emission mask, Adjacent Channel Power, Spurs, noise	21
II	Direct conversion Receiver, Issues-DC offset, LO Self mixing, Interference leakage, 1/f noise, LO Pulling, Even order distortion I/Q mismatch, Heterodyne Receiver, IF frequency selection, Tradeoffs, Issues-Image Problem, Half IF problem, Dual IF Topology, Image Reject Receivers-Hartley and Weaver Architectures, Low noise amplifier (LNA), LNA Topologies, Mixers, Two-port and Three port mixers, Gilbert Mixer, Sources of non-linearity and noise in Gilbert Mixers, , Oscillators , RC and LC oscillators , Cross-coupled LC Oscillators ,Power Amplifiers-Linear and Switching type Power Amplifiers	22

Text Books:

- RF Microelectronics by BehzadRazavi. Pearson, 2012.

Reference Books:

- The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2006.

Focus: This course focuses on employable aligned with CO2, CO3 and CO4.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the basic principle of RF design and its tradeoff.
2. Analyze the performance parameters of radio frequency circuits.
3. Classify different typical transceiver architectures.
4. Design typical blocks of RF transceivers, including standard matching circuits, low-noise amplifiers, mixers, power amplifiers and RF oscillators.

PECE0017: OPTOELECTRONIC DEVICES

Objectives:

- Describe fundamental and applied aspects of optoelectronic device physics and its applications to the design and operation of optical waveguide and electro optic modulators.
- Analyze optoelectronic device characteristics in detail using concepts from quantum mechanics and solid-state physics.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Optical wave guides** Integrated optic – Substrate materials for optical integrated circuits – Optical wave, guide modes – theory of planer wave guides – symmetric and symmetric slab wave guides – channel waveguides – strip loaded waveguides – losses in optical waveguides. Transverse couplers – prism couplers – Grating Tapered couplers – Fiber to waveguides couplers. **Electro optic modulators** Characteristics of switches and modulators – Electro optic effect – Single and dual channel wave guides – electro – optic modulator – Mach Zehnder type electro – optic modulator – Comparison of waveguides modulators.	21
II	**Acousto – Optic Modulator** Principle of acousto – optic effect – Raman – Nath type modulator – Bragg type deflectors and switches acousto – optic frequency shifters. **Magneto Optic Devices** Characteristics of magneto Optic effect – Non – reciprocal waveguides – Interaction between magnetic spin wave and Optic wave – Optical isolator – Optical isolator –Optical filter. **Non Linear Fiber Optics and Applications** Fiber non linar ties – Optical solutions – Non linear birefringence effects – Optical pulse compression – RF spectrum analyzer – Analog to digital converter – integrated optic Doppler velcimeterOpto electronic integrated circuits – Opto microwave applications.	22

Text books:

- R. G. hullsperger. Integrated Optics : Theory and Technology springer, verlag series, 1991.
- G. P. Agarwal, Non linear Optics, Academic Press, 1989.

Reference Books:

- J.wilson& J.F.B. Hawkes, Optoelectronics : An introduction Prentice hall Inter nations
- series, 1983.

- L. J. Pinsion. Electro optics, John Willy & sons, 1085.
- L. Sharupic. N. Tugliv, Optoelectronics, MIR Publicashers. 1987.

Focus: This course focuses on employable aligned with CO2 and CO3.

Course Outcomes: After successfully completing the course students will be able to

1. Understand the state-of- the art optoelectronic technology.
2. Demonstrate the properties of light and operation principles of basic optical components.
3. Investigate semiconductor material properties and semiconductor opto-electronic device physics.

PECE0018: VLSI TESTING & TESTABILITY

Objectives: This course covers introduction to the concepts and techniques of VLSI verification and testing. Details of test economy, fault modeling and simulation, defects, Automatic Test Pattern Generation (ATPG), design for testability and built-in self-test (BIST) also covered.

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Fault modeling and simulation:** Physical Faults and their modeling; Stuck at Faults, Bridging Faults, Fault detection, Fault Equivalence, Fault Dominance, Fault Collapsing and Checkpoint Theorem; General fault simulation techniques serial, parallel, concurrent and deductive fault simulation, critical path tracing, statistical fault analysis. **Combinational Circuit Test Pattern Generation:** Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras ,ATPG for single stuck-at faults and multiple stuck-at faults **Sequential Circuit Testing and Scan Chains:** ATPG for Single-Clock Synchronous Circuits, Use of Nine-Valued Logic and Time-Frame Expansion Methods, Complexity of Sequential ATPG	22
II	**Scan Chain based Sequential Circuit Testing** Scan Cell Design, Design variations of Scan Chains, Sequential Testing based on Scan Chains, Overheads of Scan Design, Partial-Scan Design **Design for testability:** Ad-hoc design for testability- test points, oscillators and clocks, logical redundancy; Controllability and observability, boundary scan partial/ full scan, serial and non-serial scan; boundary scan standard; Compression techniques; **Memory BIST** March Test, BIST with MISR, Neighborhood Pattern Sensitive Fault Test, Transparent Memory BIST	21

Text book:

- Abramovici, M., Breuer, M. A. and Friedman, "*A. D. Digital Systems Testing And Testable Design*". IEEE press (Indian edition available through Jayco Publishing house), 2001.

Reference Books:

- Abramovici, M., Breuer, M. A. and Friedman, "*A. D. Digital Systems Testing And Testable Design*". IEEE press (Indian edition available through Jayco Publishing house), 2001.
- Bushnell and Agarwal, "*V. D. VLSI Testing*", Kluwer.

- Agarwal, V. D. and Seth, S. C. “*Test Generation For VLSI Chips”*. IEEE computer society press.
- Hurst, S. L. “*VLSI Testing: Digital And Mixed Analog/Digital Techniques”*. INSPEC/IEE, 1999.

Focus: This course focuses on employable aligned with CO3 and CO4.

Outcomes:

1. Identify the significance of testable design.
2. Understand the concept of yield and identify the parameters influencing the same.
3. Analyse fabrication defects, errors and faults.
4. Design combinational and sequential circuit test generation algorithms.

PECE0019: BIOMEDICAL SIGNAL PROCESSING

Objectives: Objective of this course is to make students familiar with different types of biomedical signals and their analysis.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Discrete and continuous Random variables, Probability distribution and density functions. Gaussian and Rayleigh density functions, Correlation between random variables. Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth, noise figure of systems. Data Compression Techniques: Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Hoffman coding, vector quantisation, DCT and the K L transform.	22
II	Cardiological Signal Processing: Pre-processing. QRS Detection Methods. Rhythm analysis. Arrhythmia etection Algorithms. Automated ECG Analysis. ECG Pattern Recognition. Heart rate variability analysis. Adaptive Noise Canceling: Principles of Adaptive Noise Canceling. Adaptive Noise Canceling with the LMS daptation Algorithm. Noise Canceling Method to Enhance ECG Monitoring. Fetal ECG Monitoring. Neurological Signal Processing: Modeling of EEG Signals. Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive(A.R.) modeling of seizure EEG. Sleep Stage analysis. Inverse Filtering. Least squares and polynomial modeling.	22

Text Book:

D.C.Reddy, Biomedical Signal Processing- principles and techniques, Tata McGraw-Hill, 2005

Reference Books:

- Biomedical Digital Signal Processing, Willis J.Tompkins, PHI,
- Rangaraj M. Rangayyan – Biomedical Signal Analysis. IEEE Press, 2001.

Focus: This course focuses on employable aligned with CO3 and CO4.

Course Outcomes: After successfully completing the course students will be able to

CO1: Understand techniques for various levels of processes in biomedical signal analysis.
CO2: Demonstrate appropriate algorithms according to nature of the signal and acquisition characteristics.
CO3: Apply biomedical signal processing algorithms using appropriate tools like MATLAB.
CO4: Develop contemporary algorithms to address complex problems.

PECC0020: OPTIMAL CONTROL SYSTEM

Objectives:

- To have complete familiarity with Calculus of Variation.
- To understand different forms of performance measures as applied to variety of optimal control problems.
- To model linear quadratic regulator problem.
- To understand Pontryagin's minimum principle.
- To apply dynamic programming.
- To motivate students towards research work on the subject.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**OPTIMAL CONTROL PROBLEMS:** Statement of optimal control problem - Problem formulation and types of optimal control - Selection of performance measures, General Model of feedback control systems, Transient performance analysis, Tracking performance analysis, Disturbance rejection analysis, Cost functions and norms, Mathematical preliminary to optimal control. **CALCULUS OF VARIATION AND HAMILTON FORMULATION:** Fundamental concepts - Extremum functionals involving single and several independent functions – Piecewise smooth extremals - Variation of functionals with fixed and free terminal time constrained extrema Pontryagin's minimum principle - State inequality constraints - The Weierstrass Erdmann corner conditions - Solution of Bolza problem. Partial differential equation for cost function - Hamilton Jacobi equation - Principle of optimality, solution of Hamilton Jacobi equation - Matrix Riccati equation - Optimal control law. **LINEAR QUADRATIC CONTROL PROBLEMS:** Optimal control by Liapunov method - Parameter optimization – Quadratic performance index - Optimal control of systems - Matrix Riccati equation and solution methods of State regulator and discrete systems - Choice of weighting matrices – Linear Quadratic Guassian control – Kalman filter – H_2 and $H\infty$ Control and Optimal estimation.	24
II	**DYNAMIC PROGRAMMING:** Principle of optimality - Recurrence relation of dynamic programming for optimal control problem - Combinational procedure for solving optimal control problem. **DISCRETE TIME SYSTEMS:** Solution of general discrete optimization problem - Discrete time linear quadratic regulator - Suboptimal feedback - Regulator problem with functions of final state fixed. Time optimal and fuel optimal control problems - Minimum time	21

	control problem, Uniqueness of control - Bang bang control – Case study-Aero space applications-Fuel optimal systems.	

Text Books:

- Kirk D E, "Optimal Control Theory: An Introduction", Prentice Hall, New Jersey, 2008.
- Brian D O Anderson and John B Moore, "Optimal Control - Linear Quadratic Methods", Prentice Hall of India, 1991.

Reference Books:

- Jeffrey B Burl, "Linear Optimal Control", Addison-Wesley, California, 1999.
- Frank L Lewis, "Optimal Control", John Wiley & Sons, New York, 1986.
- Gopal M, "Modern Control System Theory", Wiley Eastern, New Delhi, second Edition, 1993.
- Michael Athens. "Optimal Control", Tata McGraw Hill Publishing Company Ltd., 1996.

Focus: This course focuses on employable aligned with all COs.

Course Outcomes: After successfully completing the course students will be able to

1. Apply knowledge of advanced principles to the analysis of electrical and computer engineering problems.
2. Apply the appropriate industry practices, emerging technologies, state-of- the-art design techniques, software tools, and research methods in the field optimal control.
3. Model the LQR problem.
4. Design the optimal controller.

PECE0021: CAD FOR VLSI CIRCUITS

Objectives:

- The design of all VLSI circuits is carried out by making extensive use Computer Aided Design (CAD) VLSI design tool.
- As part of the present introductory course the principles of operation of all the important modules that go into the construction of a complete VLSI CAD tool will be discussed.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**VLSI DESIGN METHODOLOGIES** Introduction to VLSI Design methodologies - Review of Data structures and algorithms - Review of VLSI Design automation tools - Algorithmic Graph Theory and Computational Complexity - Tractable and Intractable problems - general purpose methods for combinatorial optimization. **DESIGN RULES** Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning - Circuit representation - Placement algorithms - partitioning	21
II	**FLOOR PLANNING** Floor planning concepts - shape functions and floorplan sizing - Types of local routing problems -Area routing - channel routing - global routing - algorithms for global routing. **SIMULATION** Simulation - Gate-level modeling and simulation - Switch-level modeling and simulation -Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis. **MODELLING AND SYNTHESIS** High level Synthesis - Hardware models - Internal representation - Allocation assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.	21

Text books:

- S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

Reference Books:

- N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic
  Publishers, 2002.

Focus: This course focuses on employable aligned with CO2, CO3 and CO4.

Course Outcomes: After successfully completing the course students will be able to

1. Understand VLSI design automation tools.
2. Analyse high-level synthesis.
3. Apply floor-planning concepts.
4. Design algorithms for placement and partitioning.

PECE0026: MEMORY DESIGN AND TESTING

Objectives:

- Get complete knowledge regarding different types of memories and their architectural techniques of memories.
- Analyze different parameters that lead malfunctioning of memories.
- Design reliable memories with efficient architecture to improve processes times and power.
- Design memory circuits with low power dissipation.

L–T–P: 4–0–0

Credits: 04

Module No:	Content	Teaching Hours
I	Introduction to SRAM, SRAM Architecture, SRAM Design Issues and Challenges, SRAM Bit-cell Topologies, Design Metrics of SRAM Bit-cell, Standard 6T SRAM Bit-cell: An Overview, Other SRAM Bit-cell Stability Metrics, Bit-line Measurement Design Metrics, Dynamic Stability Analysis, Single-Ended SRAM Bit-cell Design, Single-Ended 6T SRAM (SE-SRAM) Bit-cell, Read Stability and Write Ability Margins, Performance and Power Dissipation,2-Port SRAM Bit-cell Design, 2-Port 6T SRAM Bit-cell, Reconfigured Read-Port of a 2-Port 6T Bit-cell, SRAM Process Variation Sensitivity,	23
II	SRAM Bitcell Design Using Unidirectional Devices. Tunneling Transistors Development of TFETs Behavioural Model, NBTI and Its Effect on SRAM, The Physics of Negative Bias Temperature Instability NBTI Model SRAM Bitcells Under NBTI Effect of NBTI Under Process Variation Dynamic Random Access Memories (DRAMs):DRAM Technology Development-CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Strucutures-BiCMOS DRAMs-Soft Error Failures in DRAMs-Advanced DRAM Designs and Architecture-Application Specific DRAMs. Memory Fault Modeling, Testing, And Memory Design For Testability And Fault Tolerance RAM Fault Modeling, Electrical Testing, Peusdo Random Testing-Megabit DRAM Testing-Nonvolatile Memory Modeling and Testing-IDDQ Fault Modeling and Testing-Application Specific Memory Testing.	22

Text/ References books:

- Jawar Singh, Saraju P. Mohanty, Dhiraj K. Pradhan"Robust SRAM Designs and Analysis"by, ISBN 978-1-4614-0817-8, Springer New York Heidelberg Dordrecht London

- A.K Sharma, “ Semiconductor Memories Technology, Testing and Reliability”, IEEE Press.**:**
- Luecke Mize Care, “ Semiconductor Memory design & application”, Mc-Graw Hill.

Focus: This course focuses on employable aligned with all COs.

Course Outcomes: After successfully completing the course students will be able to

1. Analyse the different types of RAM, ROM designs.
2. Analyse the different RAM and ROM architecture and interconnects.
3. Analyse about design and characterization technique.
4. Analyse of different memory testing and design for testability.
5. Identification of new developments in semiconductor memory design.

OPEN ELECTIVES

OFFERED
BY

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Under

Choice Based Credit System (CBCS)

(w.e.f. 2019-20)

Open Electives (OE)
(Offered to other Departments)

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	HRS/WK	Dept Specialization
			L	T	P			
1	BECO001	Introduction to Tele-Communication Systems	4	0	0	4	4	Communication
2	BECO002	Optical and mobile Communication	4	0	0	4	4	Communication
3	BECO003	Microprocessors and Microcontrollers	4	0	0	4	4	Control
4	BECO004	Introduction To Intelligent System	4	0	0	4	4	Control
5	BECO005	Introduction to Nano-Technology	4	0	0	4	4	VLSI
6	BECO006	Microelectronics Technology & IC Fabrication	4	0	0	4	4	VLSI
7	BECO007	Bio-medical Instrumentation	4	0	0	4	4	Signal & Image Processing
8	BECO008	Fundamentals of Biometric Identification	4	0	0	4	4	Signal & Image Processing

BECO0001: INTRODUCTION TO TELECOMMUNICATION SYSTEMS

Credits: 04 **L–T–P-J: 4–0–0-0**

Course Objectives:

- To understand the different basic blocks of Tele-communication system.
- To understand the basic concepts of tele-communication theory and different types tele-communication systems
- To design mathematical model of call Birth- Death process.
- To analyze the performance of tele-communication systems in the presence of noise and interference.

Module No.	Content	Teaching Hours
I	**Telecommunications Fundamentals** Basic elements of Telecommunications, Transmission Lines, Network Connection Types, Electromagnetic Spectrum. **Analog and Digital Transmission** Frequency translation, amplitude modulation, double side band, single-sideband modulation (SSB), vestigial-sideband modulation, Angle modulation, phase and frequency modulation, radio transmitter and receiver. **Telecommunication systems I:** Multiplexing, Transmission Media, Twisted-Pair Copper Cable.	14
II	**Telecommunication systems II:** Coaxial Cable, Microwave systems, Satellite, Fiber Optics Switching and Networking Modes,Establishing Communications Channels,Public Switched Telephone Network (PSTN) Infrastructure, GSM and CDMA architecture.	14

Textbook:

Annabel Z. Dodd "*Essential Guide to Telecommunications*" Third. Edition, Prentice-Hall, Inc. ISBN: 0-13-064907-4 .TMH

Reference Books:

- B.P.Lathi and Zhi Ding "*Modern Digital and Analog Communication Systems*" fourth edition, Oxford University Press.
- S. Haykins "*Communication Systems*" 5th ed. John wiley.

Course Outcomes:
After successful completion of the course students will be able to

1. Demonstrate broad knowledge of fundamental principles and technical standards underlying.
2. Understand basic of telecommunication, networking and informationtechnologies.
3. Architect and implement networked informative systems.

4. Continuously improve their technology knowledge and communication skills.
5. Anticipate the way technological change and emerging technologies might alter the assumptions underlying architectures and systems.

Text Books:

1. Vishwanathan Thiagarajan, "*Telecommunication Switching Systems and Networking*", 2nd edition, PHI publication
2. John G. Proakis and M. Salehi, "Fundamentals of Communication Systems", Pearson Education, 2005.

References:

1. S. Haykins, "Communication Systems", 5th ed., John Wiley, 2008.
2. Taub, Schilling, "Principles of Communication System", Fourth Edition, McGraw Hill.
3. Lakshmi. G, Raman, "Fundamentals of Telecommunication Network Management", Eastern Economy Edition IEEE Press, New Delhi

Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs): Mapping of

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4
CO2	PO1,PO2, PO3, PO4
CO3	PO1,PO2, PO3, PO4
CO4	PO1,PO2, PO3, PO4

BECO0004: INTRODUCTION TO INTELLIGENT SYSTEM

Course Objectives

- **To learn the fundamental concepts of Intelligence and Artificial Intelligence.**
- **To study the concepts of Fuzzy logic and their different applications.**
- **To learn the basics of Artificial Neural Networks and its applications.**
- **To study different optimization algorithms like Genetic algorithm, Particle Swarm optimization algorithm, Cuckoo Search optimization algorithm.**

Credits: 04 **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Intelligence, Soft and Hard Computing, Artificial Intelligence.Fuzzy Logic System: Introduction to crisp sets and fuzzy sets, examples. basic fuzzy set operation.. Fuzzification, rule base, Membership functions: triangular, trapezoidal, bell shaped, guassian, sigmoidal etc. Mamdani and TSK inference methods and defuzzification. Fuzzy knowledge and rule bases. Introduction to fuzzy logic modeling of a system. Fuzzy Logic Toolbox in MATLAB. **Artificial Neural Networks:** Concept of ANN and its basic mathematical model. Feed forward networks, Multi-layered neural network.	21
II	**Artificial Neural Networks:** Learning and Training the neural network. Radial basis function networks, Recurrent neural networks, Chebyshev neural network, System identification using neural network. Neural Network Toolbox in MATLAB **Genetic Algorithm-**Basic concept of Genetic algorithm and detail algorithm steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept of some other search techniques like PSO and Cuckoo Search Algorithms for solving optimization problems in MATLAB.	21

Books:

1. Simon Haykin, “Neural Networks: Acomprehensive Foundation,” Second edition, Prentice Hall.
2. J. H. Lilly, “Fuzzy Control and Identification,” J Wiley.
3. Stuart J. Russel & Peter Norvig “Artificial intelligence: A modern approach,” Prentice Hall.

Course Outcomes

After successfully completing the course students will be able to

1. Understand the concept of fuzzy logic system.
2. Design Mamdani as well as TSK based Fuzzy Logic Controller.
3. Comprehend the fundamental notion of Artificial Neural Networks.
4. Design an ANN for training and testing of an unknown system model.
5. Apply the concepts of GA, PSO and CSA optimization algorithms for controller tuning.

Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs): Mapping of

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4
CO2	PO1, PO2, PO4
CO3	PO1, PO2, PO4
CO4	PO1, PO2, PO4
CO5	PO1, PO2, PO4

BECO0005: INTRODUCTION TO NANOTECHNOLOGY

Course Objectives

Enable the students

- To understand the basics concepts involved in the field of Nanotechnology
- To understand the nature of different types of materials used in photovoltaic applications.
- To familiarize students with latest development in solar cell industry using emerging technologies. This includes organic photovoltaics (OPVs), perovskite solar cells, dye-sensitized solar cells (DSSCs), and quantum dot solar cells.

Credits: 04 **L–T–P-J: 4–0-0–0**

Module No.	Contents	Teaching Hours
I	Introduction to nanomaterials, Properties of materials & nanomaterials, role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells,Introduction to physics of basis solar cells, Material aspect of solar cells, High efficiency solar cells, III-IV and II-VI and thin film cells, Tandem, multi junction and stacked solar cells, Solar PV concentrator cells and systems. Advanced solar cell concepts, Solar cell characteristics and characterization. Nano- , micro-, and poly crystalline and amorphous Si for solar cells, Nano-micro Si composite structure, various techniques of Si deposition.	21
II	Conjugated polymers, organic/plastic/flexible solar cells, Polymer composites for solar cells, device fabrication and characterization. Photovoltaic conversion: Optical effects of p-n junction, design and analysis of PV cells. PV cell fabrication, system design, Aplication of nano semiconductors for PV devices, Dye sensitized solar cells. Fuel Cells, Polymer membranes for fuel cells, PEM fuel cell. Acid/ alkaline fuel cells, design of fuel cells, Carbon Nanotubes for energy storage, Hydrogen Storage in Carbon Nanotubes, Use of nanoscale catalysts to save energy and increase the productivity in industry, Rechargeable batteries based on nanomaterials, Nanocomposites for electrodes and electrolyte applications.	21

Text /Refrence Books:

- Solar cells: Operating principles, technology and system applications by Martin A Green, Prentice Hall Inc, Englewood Cliffs, NJ, USA, 1981.
- Semiconductor for solar cells, H J Moller, Artech House Inc, MA, USA, 1993.
- Solis state electronic device, Ben G Streetman, Prentice Hall of India Pvt Ltd., New Delhi 1995.
- Direct energy conversion, M.A. Kettani, Addision Wesley Reading, 1970. 5. Hand book of Batteries and fuel cells, Linden, Mc Graw Hill, 1984.

Course Outcome: On the completion of this course the student will be able to

CO1-Understand the properties of Nano-materials and applications

CO2- Characterize Nano-materials.

CO3-Apply quantum ideas for understanding the operation and working principle of Solar cell

CO4-Use different Nano-materials for efficient solar cell applications.

CO5-Evaluate the electrochemical energy storage systems such as fuel cells, PEM fuel cell, Acid/ alkaline fuel cells, and design for usage in electrical and electronic applications.

Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs): Mapping of

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4
CO2	PO1, PO2, PO3, PO4
CO3	PO1, PO2, PO3, PO4
CO4	PO1, PO2, PO3, PO4
CO5	PO1, PO2, PO3, PO4

BECO0006: MICROELECTRONICS TECHNOLOGY & IC FABRICATION

Credits: 04 **L–T–P-J: 4–0–0-0**

Objectives:

1. To get acquainted with basic principles and processes on semiconductor fabrication technologies
2. Explore principles and theory of micro- and nanofabrication
3. Understand the science and technology involved in fabrication and be able to apply to future research and processes

Module No.	Contents	Teaching Hours
I	Cleanroom technology - Clean room concept – Growth of single crystal Si, surface contamination, cleaning & etching. Oxidation – Growth mechanism and kinetic oxidation, oxidation techniques and systems, oxide properties, oxide induced defects, charactrisation of oxide films, Use of thermal oxide and CVD oxide; growth and properties of dry and wet oxide, dopant distribution, oxide quality	23
II	Solid State Diffusion – Fick's equation, atomic diffusion mechanisms, measurement techniques, diffusion in polysiliconand silicon di-oxide diffusion systems. Ion implantation – Range theory, Equipments, annealing, shallow junction, high energy implementation. Lithography – Optical lithography, Some Advanced lithographic techniques. Physical Vapour Deposition – APCVD, Plasma CVD, MOCVD. Metallisation - Different types of metallisation, uses & desired properties. VLSI Process integration.	22

Text Books:

- S. M. Sze, Semiconductor Devices Physics and Technology,Notes: Wiley, 1985
- D.V. Morgan and K. Board, An Introduction to Semiconductor Microtechnology, Wiley; 2 edition (April 1990).
- S. M. Sze, "VLSI Technology", 2nd Edition, McGraw –Hill Publication.

Course Outcomes:

1. Understand the fundamentals of crystal growth methods of Silicon and GaAs
2. Describe the optical and nanolithographic methods
3. Understand concepts related to Diffusion and Ion Implantation
4. Understand, apply and analyze the fabrication processes implemented in a sequential manner
5. Comprehend and apply concepts related to metallization, low K and high K Dielectrics and integration with CMOS Technology

Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs): Mapping of

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4
CO2	PO1, PO2, PO3, PO4
CO3	PO1, PO2, PO3, PO4
CO4	PO1, PO2, PO3, PO4
CO5	PO1, PO2, PO3, PO4

BECO0007: BIOMEDICAL INSTRUMENTATION

Credits: 04 **L–T–P: 4–0–0**

Objective:

- To understand the different types of biomedical signals and their origination
- Understand the principle of transducers and specialized medical equipment.
- To analyze the performance of biomedical signal recorder.

Module No.	Contents	Teaching Hours
I	**Action Potential and Transducers:** Electrical activity in cells, tissues, muscles and nervous systems -transducers-types and characteristics Physiological transducers – pressure transducers-transducers for body temperature measurement – Pulse sensors-respiratory sensors. **Biosignal Acquisition:** Physiological signal amplifiers-isolation amplifiers-medical preamplifier design-bridge amplifiers-line driving amplifier-current amplifier – chopper amplifier-biosignal analysis – signal recovery and data acquisition-drift compensation in operational amplifiers-pattern recognition-physiological assist devices.	20
II	**Biopotential Recorders:** Characteristics of recoding system – electrocardiography (ECG) – electro encephalography (EEG) – electromyography (EMG) – electroretinography (ERG) – electrooculography (EOG) – recorders with high accuracy –recorders for OFF line analysis. **Specialized Medical Equipment:** Digital thermometer-audio meter –X-ray machines radiography and fluoroscopy – angiography – elements of bio-telemetry system-design of biotelemetry system-radio telemetry system-pace makers-Heart lung machine-Dialysis machine. **Advanced Biomedical Instrumentation:** Basic principles of endoscopes-nuclear imaging techniques – computer tomography (CT) Scanning – Ultrasonic imaging system-construction propagation and delay – magnetic resonance imaging (MRI).	21

Test Books:

- Biomedical Instrumentation and Measurements-L. Cromwell, F.J. Weibel land E. A. Pfeiffer.
- Biomedical Instrumentation- M. Arumugam – Anuradha Publications.
- Handbook of Biomedical Instruments- R.S. Khandpur.

Course Outcomes:

After the successful completion of the course students are able to

1. Understand the basic origination of action potential of human body
2. Analyze the working principle of biomedical equipment
3. Distinguish different signals of different biomedical instruments.

Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs): Mapping of

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4
CO2	PO1, PO2, PO3, PO4
CO3	PO1, PO2, PO3, PO4
CO4	PO1, PO2, PO3, PO4
CO5	PO1, PO2, PO3, PO4

BECO0008: FUNDAMENTALS OF BIOMETRIC IDENTIFICATION

Objective: This course enables the students

- To understand the different biometric modalities, fundamentals of biometric enrollment and authentication system, and system errors.
- To analyze fingerprint-based and face-based biometric system.
- To evaluate the matching accuracy of a biometric system based on predefined performance criteria such as FAR, FRR, EER, and ROC.

Prerequisites: Basic Mathematics – Knowledge and ability to use calculus, probability, and statistics are essential. Fundamental knowledge of Digital Image Processing, Programming Skills – The student should have experience in a high level programming language such as Matlab or C/C++.

Credits: 04 **L–T–P-J: 4–0-0-0**

Module No.	Contents	Teaching Hours
I	History and overview of biometrics, Introduction to biometrics traits, biometrics applications. Image processing basics: Basic image operations, filtering, enhancement, smoothening, sharpening, thresholding, . Description of Biometric system, identification, recognition, verification, authentication. Challenges in biometric system, attacks in biometric system. Biometric system modalities, face recognition: Discrete Harr wavelet transform, features template & matching.	14
II	Fingerprint recognition: Enhancement, thinning, minutiae, CN number, matching. Iris recognition: Acquisition, cropping, normalization, matching. Performance evaluation of biometric system, matching, null & alternate hypothesis h0, h1, error type I/II, matching score distribution, ROC and DET curve, CMC curve, FAR/FRR curves.	14

Text Book:

1. **Guide to Biometrics**, By: Ruud M. Bolle, Sharath Pankanti, Nalini K. Ratha, Andrew W.Senior, Jonathan H. Connell, *Springer 2009*

Reference Books:

1. **Introduction to Biometrics**, Anil K Jain, Arun A Ross and Karthik Nandkumar, springer, 2011
2. **Digital Image Processing using MATLAB**, By: Rafael C. Gonzalez, Richard Eugene Woods, *2nd Edition, Tata McGraw-Hill Education 2010*
3. **Pattern Classification**, By: Richard O. Duda, David G.Stork, Peter E. Hart, *Wiley 2007*

Course Outcomes (CO): Upon completion of this course students will be able to

CO1: Understand different biometric modalities used for person authentication, fundamental building blocks of biometric systems, system errors, and biometric applications.
CO2: Relate digital image processing with feature extraction process in biometric system.
CO3: Survey the literature related to biometric identification.
CO4: Model fingerprint and face based biometric system.

Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs): Mapping of

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4
CO2	PO1, PO2, PO3, PO4
CO3	PO1, PO2, PO3, PO4
CO4	PO1, PO2, PO3, PO4
CO5	PO1, PO2, PO3, PO4

COURSE STRUCTURE

Bachelor of Technology

Civil Engineering

Under

Choice Based Credit System (CBCS)

Semester I

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	CONTACT HRS/WK
			L	T	P		
THEORY							
1	BMAS 0101	Engineering Mathematics I	3	1	0	4	4
2	BCHS 0101/ BPHS 0001	Engineering Chemistry/ Engineering Physics	3	1	0	4	4
3	BELH0001	English Language Skills for Communication - I	2	0	0	2	2
4	BMEG 0001	Basic Mechanical Engineering	3	1	0	4	4
5	BCEG 0002	Surveying and Geoinformatics	4	1	0	5	5
PRACTICALS							
1	BCHS 0801/ BPHS 0801	Engineering Chemistry/ Engineering Physics Laboratory	0	0	2	1	2
2	BELH 0801	English Language Laboratory - I	0	0	2	1	2
3	BMEG 0800	Engineering Workshop Practice Laboratory	0	0	2	1	2
4	BCEG 0802	Surveying Laboratory	0	0	2	1	2
5	BCEG 0803	Geoinformatics Laboratory	0	0	2	1	2
TOTAL			15	4	10	24	29

Semester II

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	CONTACT HRS/WK
			L	T	P		
THEORY							
1	BMAS 0102	Engineering Mathematics II	3	1	0	4	4
2	BPHS 0001/ BCHS 0101	Engineering Physics/ Engineering Chemistry	3	1	0	4	4
3	BELH 0002	English Language Skills for Communication - II	2	0	0	2	2
4	BECG 0001	Electrical Engineering	3	1	0	4	4
5	BCSG 0001	C Programming	4	1	0	5	5
6	BCEG 0001	Fundamental of Mechanics	3	1	0	4	4
PRACTICALS							
1	BPHS 0801/ BCHS 0801	Engineering Physics / Engineering Chemistry Laboratory	0	0	2	1	2
2	BELH 0802	English Language Laboratory - II	0	0	2	1	2
3	BECG 0800/ BEEG 0800	Electronics Laboratory/ Electrical Engineering Laboratory	0	0	2	1	2
4	BCSG 0800	C Programming Laboratory	0	0	2	1	2
5	BCEG 0800	Engineering Graphics Laboratory	0	0	2	1	2
TOTAL			18	5	10	28	33

. NO .	CODE	SUBJECT	TEACHING SCHEME				CREDIT	CONTACT HRS/WK	PREREQUISITE
			L	T	P	J			
1	BCEC 0001	Mechanics of solids	3	1	0	0	4	4	
2	BCEC 0002	Structural analysis	3	1	0	0	4	4	BCEC 0001
3	BCEC 0003	Concrete Structure	3	1	0	0	4	4	BCEC 0002
4	BCEC 0004	Design of Steel Structures	3	1	0	0	4	4	BCEC 0001
5	BCEC 0005	Quantity Surveying and Estimation	3	1	0	0	4	4	
6	BCEC 0006	Building Materials and Geology	3	0	0	0	3	3	
7	BCEC 0007	Construction Management and Equipments	3	0	0	0	3	3	
8	BCEC 0101	Mechanics of fluid	2	1	0	0	3	3	
9	BCEC 0102	Open channel hydraulics	2	0	0	0	2	2	BCEC 0101
10	BCEC 0103	Water Resourse Engineering	2	1	0	0	3	3	BCEC 0101
11	BCEC 0201	Geotechnical Engineering	3	1	0	0	4	4	
12	BCEC 0301	Transportation Engineering	3	1	0	0	4	4	
13	BCEC 0401	Environmental Engineering	3	1	0	0	4	4	
PRACTICALS									
14	BCEC 0800	Fluid Mechanics Laboratory	0	0	2	0	1	2	
15	BCEC 0802	Structural analysis Laboratory	0	0	2	0	1	2	

16	BCEC 0803	Structural Detailing Laboratory	0	0	2	0	1	2	
17	BCEC 0804	CAD Laboratory	0	0	2	0	1	2	
18	BCEC 0806	Geotechnical Engineering Laboratory	0	0	2	0	1	2	
19	BCEC 0807	Transportation Engineering Laboratory	0	0	2	0	1	2	
20	BCEC 0808	Environmental Engineering Laboratory	0	0	2	0	1	2	
21	BCEC 0811	Channel Hydraulics Laboratory	0	0	2	0	1	2	
TOTAL			30	10	16	0	48	56	

professional Electives

Bouquet I: Structural Engineering

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDIT	CONTACT HRS/WK	PREREQUISITE	COREQUISITE
THEORY										
1	BCEE 0001	Advanced Design of Steel Structure	3	1	0	0	4	4	BCEC 0004	
2	BCEE 0002	Bridge Engineering	3	1	0	0	4	4	BCEC 0003	
3	BCEE 0003	Advanced Design of Concrete Structure	3	1	0	0	4	4	BCEC 0003	
4	BCEE 0004	Matrix Analysis of Structure	3	1	0	0	4	4	BCEC 0002	
5	BCEE 0005	Plastic Analysis of Structure	3	1	0	0	4	4	BCEC 0002	
6	BCEE 0008	Construction Engineering	3	0	0	0	3	3		
7	BCEE 0007	Introduction to Earthquake Engineering	3	0	0	0	3	3		
8	BCEE 0011	Structural Dynamics	3	1	0	0	4	4		
9	BCEE 0009	Advanced Construction Engineering	3	0	0	0	3	3		BCEE 0801 & BCEJ 0001
10	BCEE 0010	Earthquake Resistant Design	3	0	0	0	3	3		BCEE 0802 & BCEJ 0002
PRACTICAL										
11	BCEE 0801	Construction Engineering Laboratory	0	0	2	0	1	2		
12	BCEE	Computational Laboratory for	0	0	2	0	1	2		

	0802	Seismic Analysis								
13	BCEE 0803	Advanced Construction Engineering laboratory	0	0	2	0	1	2		
PROJECT										
14	BCEE 0109	Construction Engineering Project	0	0	0	8	2	0		
15	BCEE 0110	Earthquake Resistant Design Project	0	0	0	8	2	0		

Bouquet II: Geotechnical Engineering

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDIT	CONTACT HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P	J				
THEORY										
1	BCEE 0101	Foundation Engineering	3	0	0	0	3	3	BCEC 0201	
2	BCEE 0102	Ground Improvement Engineering	3	0	0	0	3	3	BCEC 0201	
3	BCEE 0103	Earth and Earth retaining structure	3	1	0	0	4	4	BCEC 0201	
4	BCEE 0104	Geotechnical Exploration & Measurement Technique	3	1	0	0	4	4	BCEC 0201	
5	BCEE 0105	Advanced Foundation Design	3	1	0	0	4	4	BCEE 0101	
6	BCEE 0106	Advanced Foundation Engineering	3	0	0	0	3	3	BCEC 0201	BCEE 0803 & BCEJ 0003

7	BCEE 0108	Geosynthetic and Reinforced Soil Structures	3	0	0	0	3	3	BCEC 0201	BCEE 0804 & BCEJ 0004
PRACTICAL										
9	BCEE 0804	Geosynthetics Testing Laboratory	0	0	2	0	1	2		
PROJECT										
10	BCEJ 0003	Foundation Engineering Project	0	0	0	8	2	0		
11	BCEJ 0004	Geosynthetic And Reinforced Soil Structures Project	0	0	0	8	2	0		

Bouquet III: Water Resource Engineering & Environmental Engineering

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDIT	CONTACT HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P	J				
THEORY										
1	BCEE 0214	Engineering Hydrology	3	1	0		4	4		
2	BCEE 0202	Ground Water Management	3	1	0		4	4		
3	BCEE 0203	Hydro Power Engineering	3	1	0		4	4		
4	BCEE 0204	Hydraulic Structures	3	1	0		4	4	BCEC 0103	
5	BCEE 0211	Introductory Rural water Supply	3	0	0		3	3	BCEC 0401	
6	BCEE 0206	Introduction to Climate Change studies	3	0	0		3	3	BCEC 0401	
7	BCEE 0207	Environmental Instrumentation AndAnalysis	3	1	0		4	4	BCEC 0401	

8	BCEE 0208	Advanced Geoinformatics	3	0	0		3	3		
9	BCEE 0209	Applied Hydrology	3	0	0	0	3	3		BCEE 0805 & BCEJ 0005
10	BCEE 0210	Advanced Climate Change and Modelling	3	0	0	0	3	3		BCEE 0806 & BCEJ 0006
11	BCEE 0212	Advanced Water Treatment Technologies	3	0	0	0	3	3		BCEE 0807 & BCEJ 0007
PRACTICAL										
10	BCEE 0805	Applied Hydrology Laboratory	0	0	2	0	1	2		
11	BCEE 0806	Experimental Analysis of Climate	0	0	2	0	1	2		
12	BCEE 0807	Advanced Water Treatment Technologies Laboratory	0	0	2	0	1	2		
PROJECT										
13	BCEJ 0005	Applied Hydrology Project	0	0	0	8	2	0		
14	BCEJ 0006	Climate Change Modelling Project	0	0	0	8	2	0		
15	BCEJ 0007	Water Treatment Project	0	0	0	8	2	0		

Bouquet IV: Transportation Engineering & Construction Management

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDIT	CONTACT HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P	J				
THEORY										
1	BCEE 0301	Railway Engineering	3	1	0		4	4		
2	BCEE 0302	Basics of Transportation System and Planning	3	0	0		3	3		
3	BCEE 0303	Airport Planning and design	2	1	0		3	3	BCEC 0301	
4	BCEE 0304	Basics of Traffic Engineering	3	0	0		3	3	BCEC 0301	
5	BCEE 0305	Construction Technology & Management	2	1	0		3	3		BCEE 0800
6	BCEE 0306	Transportation System and Planning	3	0	0	0	3	3		BCEE 0808 & BCEJ 0008
7	BCEE 0307	Advanced Traffic Engineering	3	0	0	0	3	3		BCEE 0809 & BCEJ 0009
8	BCEE 0314	Traffic Engineering	4	0	0		4	4		
PRACTICALS										
8	BCEE 0800	Computer Aided Estimation & Planning Laboratory	0	0	2	0	1	2		
9	BCEE 0808	Traffic Simulation And Analysis Laboratory	0	0	2	0	1	2		
10	BCEE	Traffic Engineering	0	0	2	0	1	2		

	0809	Laboratory								
PROJECT										
11	BCEJ 0008	Transportation System and Planning Project	0	0	0	8	2	0		
12	BCEJ 0009	Advanced Traffic Engineering Project	0	0	0	8	2	0		

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P	J				
1	BCEJ 0962	Industrial Training	0	0	0	0	2	0		
2	BCEJ 0950	Mini Project	0	0	0	0	4	0		
3	BCEJ 0971	Project I	0	0	0	0	3	0		
4	BCEJ 0972	Project II	0	0	0	0	8	0		
Total			0	0	0	0	17	0		

BCEG 0102: BASIC SURVEYING

Objective: *This course aims to introduce the fundamental surveying and geoinformatics theories, techniques and instruments that are used in civil engineering surveys besides providing practical skills that will be useful for the field work.*

Credits: 05 **L-T-P-J: 4-1-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction**: Basic concepts of surveying -objectives types of surveying unit of measurement and their types. Linear measurements: Direct distance measurement (chaining and taping), Optical distance measurement, EDM, errors in distance measurement and precautions or corrections **Angle Measurements**: Concept of direction, bearing and azimuths magnetic declination, compass surveying local attraction, theodolite, fundamental charact eristics of theodolite and adjustments, measurements of horizontal angle, sources of error. **Vertical Control**: Levelling principles basic terms and definitions leveling instruments determination of height, booking and reduction of field notes, sources of error and minimization, curvature and refraction effects, types of levelling Trigonometrical levelling contours characteristics methods of contouring principles of stadia systems Subtense bar and tangential methods.	25
II	**Position and Control Survey**: Control Networks Control Survey Traversing Triangulation, Trilateration, and Triangulateration: types field procedure, error minimization, Coordinate systems and datum transformation-Important surfaces in geodesy: earth surface, geo id, MSL, reference ellipsoid, Reference systems 2D and 3D coordinate systems and transformations map projection, UTM projection, plane table surveying **Errors and adjustments**: Sources of errors, types accuracy and precision, propagation of variance/covariance and adjustment of errors. **Curves**: Principle of setting out, special instruments for setting out, setting out a highway curve, elements of simple circular curves theory and methods of setting out simple circular curves Transition curves- types and their characteristics, Ideal transition curve, equations of various transition curves introduction to vertical curves. **Photogrammetry**: Scales relief displacement, flight planning characteristics of photographic image, fundamentals of aerial photo-interpretation, application of photogrammetry, stereoscopy, Stereo- parallax measurements Introduction to Remote Sensing basic concepts of GIS and GPS	25

Text Books:

- K.R, Arora Surveying, Vol. 1 and 2. Standard Book House, New Delhi. (2010).
- S.K. Duggal, Surveying, Vol. 1 and 2, Tata McGraw Hill Education Private Limited, Noida. (2009)
- T.P. Kanetkar, and Kulkarni, S.V. Surveying and Levelling, Vol. 1 and 2, Vidyarthi Griha Prakashan (2008),
- B.C Punmia, Jain, A.K., and A.K. Jain, Surveying and Levelling, Vol. 1 and 2, Standard Publishers, New Delhi. (2005),

Reference Books

- W. Schofield, and M.Breach, Engineering Surveying, Butterworth-Heinemann publisher R. Subramanian, Surveying and Levelling, Oxford University Press, New Delhi. (2007),

- C. Venkatramaiah, Text Book of Surveying, University Press, Hyderabad. (2011),

Focus: This course is employable under CO2 and CO3
Outcome: *At the end of the course the student will be able to*
- CO1: Illustrate earth geometrics, types of scale and linear measurements using direct and electronic distance-measuring techniques.
- CO2: Determine horizontal angles, vertical angles, and height of any point using a compass, theodolite, and total station.
- CO3: Describe leveling and its type along with the curvature and refraction.
- CO4: Explain triangulation, trilateration, errors, and adjustments in surveying.
- CO5: Understand curves, photogrammetry, relief displacements, stereoscopy, and the use of remote sensing, GPS, and GIS in advanced surveying.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO12/PSO2
CO2	PO1,PO2,PO12/PSO2,
CO3	PO1,PO2,PO3,PO12/PSO2
CO4	PO1,PO2,PO12/PSO2, PSO3
CO5	PO1,PO2,PO12/PSO2, PSO4

BCEG 0802: SURVEYING LABORATORY

Objective: *To gain knowledge about Survey field techniques.*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I	• Introduction to surveying techniques • Chain Surveying • Compass Surveying (Prismatic and Surveyor) • Level Surveying(levelling) • Theodolite Surveying • Plane Table Surveying • Total Station Surveying • GPS	20

Text Books:

- K.R, Arora Surveying, Vol. 1 and 2. Standard Book House, New Delhi. (2010).
- S.K. Duggal, Surveying, Vol. 1 and 2, Tata McGraw Hill Education Private Limited, Noida. (2009)
- T.P. Kanetkar, and Kulkarni, S.V. Surveying and Levelling, Vol. 1 and 2, Vidyarthi Griha Prakashan (2008),
- B.C Punmia, Jain, A.K., and A.K. Jain, Surveying and Levelling, Vol. 1 and 2, Standard Publishers, New Delhi. (2005),

Reference Books

- W. Schofield, and M.Breach, Engineering Surveying, Butterworth-Heinemann publisher R. Subramanian, Surveying and Levelling, Oxford University Press, New Delhi. (2007),
- C. Venkatramaiah, Text Book of Surveying, University Press, Hyderabad. (2011),

Focus: This course is skill development under CO2 and CO3
Outcome: After completion of course, the student will be able to:

- CO1: Understandthe basic surveying techniques
- CO2: Fundamentals of levelling
- CO3: Develop basic know about theodolite.
- CO4: Understand the Electronic Distance Measuring techniques

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1

BCEG 0803: GEOINFORMATICS LABORATORY

Objective: *To learn different practical aspects of Remote Sensing, GIS and GPS*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Contents	Teaching Hours
I	• Measurement of Coordinates using GPS receiver • Geo-referencing of Satellite Image using GIS software • Shape file creation and Attribute table date entry using GIS software. • Digitization of physical features on a map/image using GIS software. • Classification of Image using Remote Sensing Software. • Land use and Land cover Mapping using Remote Sensing Software • Demonstration and working with Mirror stereoscopes and Aerial photographs. • Visual and Digital Interpretation of standard FCC (False colour composite) using Interpretation keys.	**20**

Text Books:

- M. Reddy Anji, *Textbook of Remote Sensing and Geographical Information systems*, BS Publications, Hyderabad. 2011
- M. Thomas Lillesand, W. Ralph Kiefer, W. Jonathan *Chipman Remote sensing and image interpretation* John Wiley & Sons, 2008

Reference Books:

- Kang tsung Chang*, Introduction to Geographical Information System*, Tata McGraw Hill, 7th edition, 2010
- A.M. Chandra and S.K. Ghosh*. Remote Sensing and Geographical Information system*. Narosa Publishing House, New Delhi. 2006

- **Focus:** This course is skill development under CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the different types of software of Geo-Informatics
- CO2: Learn to Digitization, Geo-referencing, and image classification
- CO3: Understand the Practical Use of GPS Receiver
- C04: Understand the Remote Sensing process
- C05: Understand the image interpretation using FCC

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1

CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

BCEC 0101: FUNDAMENTAL OF MECHANICS

Objective: *This course includes basics of mechanics, role of scalers and vectors, equilibrium of forces, friction and their role in civil engineering.*

Credits: 05 **L-T-P-J: 4-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Scalars and Vectors, Vectors addition of Forces, Addition of Coplanar forces, Cartesian Vectors, Position Vectors, Forces along a line, Dot product **Equilibrium:** Equilibrium of a Particle and Free –Body Diagrams, Coplanar Force System, Three-Dimensional Force Systems, Cross Product, Moment of a Force and Principle of Moments, Moment about an axis, Moment of a Couple **Forces:** Forces and couple Systems, Distributed Loading, Equilibrium of a Rigid Body in 2-D and 3-D, Simple trusses, The Method of Joints, Zero Force Members, The Method of Sections, Frame and Machines.	25
II	**Shear Force and Bending Moment Diagrams:** Internal Forces, Shear and Moment Equations and Diagrams for Different Types Loadings **Dry Friction:** Dry Friction, Problems Involving Dry Frictions Center of Gravity and Centroid for Composite Bodies, Moment of Inertia for Areas, Parallel –Axis Theorem, Moment of Inertia for Composite Areas.	25

Text Books:

- Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
- Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

Reference Books:

- Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
- Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
- Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
- Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics – Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
- Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

Focus: This course is skill employability under CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Illustrate scalers and vectors, vector addition, vector multiplication etc.
- CO2: Determine Equilibrium of a Particle and Free –Body Diagrams, Coplanar and three-dimensional Forces, Cross Product, Moment of a Force and Principle of Moments, Moment about an axis, Moment of a Couple.
- CO3: Calculate Forces and couple Systems, Equilibrium of a Rigid Body, Simple trusses, The Method of Joints, Zero Force Members, The Method of Sections.
- CO4: Explain Shear Force and Bending Moment and their diagrams for different loadings.
- CO5: Compare dry friction, center of gravity, centroid for Composite Bodies, Moment of Inertia for Areas, Parallel –Axis Theorem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO2
CO2	PO1,PO2 /PSO2
CO3	PO1,PO3 /PSO2
CO4	PO1,PO3 /PSO2
CO5	PO1,PO2 /PSO2

BCEC 0001: MECHANICS OF SOLIDS

Objective: *To provide basic knowledge in mechanics of materials so that the students can solve real engineering problems and design engineering systems.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction**: Classification of structures, Free body diagram, Equilibrium equations, Static and kinematic determinacy. **Concept of stress at a point:** Plane stress case: Transformation of stresses at a point, principle stresses and Mohr's circle; Displacement field, Concept of strain at a point, Plane strain case: transformation of strain at a point, principle strains and Mohr's circle, Strain Rosette **Stresses in Beams:** Review of Pure Bending**,** Shear Stresses in Beams due to Transverse Loading, Composite Beams. **Review of Torsion** Combined Bending and Torsion of Solid, Hollow circular Shafts, Strain energy due to torsion	20
II	**Columns and Struts:** Combined Bending and Direct Load on Short Column, Middle Third and Middle Quarter Rules, Euler's theory for Long Columns, Rankine-Gordon Formula, and Simple Cases of Beam Columns. **Deflection of Beams:** Equation of Elastic Curve, Slope and Deflection method, Double Integration Method, Moment Area Method, Conjugate Beam Method. **Strain Energy**: Strain energy of deformable systems, Maxwell's reciprocal and Betti's theorem, Castigliano's first theorem, Unit load method	20

Text Books:

- J.P Singh, "A Textbook of Mechanics of Solids", New Delhi, Khanna Publishers, 2000.
- Rattan, Strength of Materials, 2e McGraw Hill Education India, 2011
- S.Jose, Sudhi Mary Kurian, Mechanics of Solids, Pentagon, 2015

Reference Books:

- J.M. Gere, and S.P Timoshenko, "*Mechanics of Materials*", New Delhi, CBS Publishers, 2004.
- R.C. Hibbeler, "*Mechanics of Materials*", New Delhi, Pearson Education Limited, 2007.
- M. Merriman, , "*Mechanics of Materials*", New York, USA, John Wiley and Sons, 2010.
- A. Pytel, and J. Kiusalaas, , "*Mechanics of Materials*", New Delhi, Ceneage Learning, 2003.
- G.H Ryder, "*Strength of Materials*", New Delhi, Macmillan India Limited, 2002.
- J.P. Singh, , "*A Textbook of Mechanics of Solids*", New Delhi, Khanna Publishers, 2000.

Focus: This course focuses on employability aligned with CO3 and CO4

Course Outcomes:

Upon successful completion of this course, the student will be able to:

- CO1: Understand the static equilibrium equation; its use to find out the forces and stresses
- CO2: Discuss the theory of elasticity including strain/displacement and Hooke's law relationships
- CO3: Solve torsion problems in bars and thin walled members;
- CO4: Apply various failure criteria for general stress states at points
- CO5: Obtain solutions to column buckling and plate problems;
- CO6: Analyze solid mechanics problems using classical methods and energy methods

	POs / PSOs
CO1	PO1, PO2/PSO2

CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

BCEC 0002: STRUCTURAL ANALYSIS

Objectives:

- To impart the principles of elastic structural analysis and behavior of indeterminate structures
- To impart knowledge about various methods involved in the analysis of indeterminate structures
- To apply these methods for analyzing the indeterminate structures to evaluate the response of structures
- To make the student familiar with latest computational techniques and software used for structural analysis

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction**: Analysis of Complex and Compound trusses. **Rolling Loads and Influence Lines**: Rolling loads, Cases of single concentrated load, Uniformly distributed load, Several concentrated loads, Influence lines for beams and trusses, Absolute maximum bending moment, Muller-Breslau's principle and its application to determinate structures. **Influence Lines**: Indeterminate Structures using Muller-Breslau's principle	20
II	**Analysis of Three-Hinged Arches**: Three hinged parabolic and circular arch, Spandrel braced arch, Influence lines for three-hinged arch, Linear arch, Eddy's theorem. **Analysis of Two-Hinged Arches**: Analysis of horizontal thrust, Bending moment, Normal thrust, and Radial shear, Influence lines. **Analysis of Indeterminate Structures:** Slope-Deflection method, Moment Distribution method, Strain Energy method for Fixed beams, Continuous beams, Propped cantilevers and Simple frames with or without joint displacement.	20

Text Books:

- C.S Reddy,.*Basic Structure Analysis*, New Delhi: Tata McGraw-Hill; 2005.
- T. S Thandavamoorthy. *Analysis of Structures: Strength and Behaviour*, New Delhi: Oxford University Press; 2005.

Reference Books:

- R. Hibbeler. C.*Structural Analysis*, New Delhi: Pearson Publishers; 2008.
- A.K. Jain,., *Theory and Analysis of Structures, Vol. I and II,* Roorkee: Nem Chand & Bros; 2009.
- C.H. Norris and J.B. Wilbur.*Elementary Structural Analysis*, New Delhi: Tata McGraw Hill; 2007.
- V.N. Vazirani, M.M. Ratwani, and S.K. Duggal, *Structural Analysis of Structures*, Vol. 1 and 2,17th edition, New Delhi: Khanna Publishers; 2000.
- C.B Kukreja,*Indeterminate Structural Analysis* New Delhi: Standard Publishers Distributors; 2000.
- O.P. Jain, and B.K. Jain, *Theory and Analysis of Structures, Vol. I and II*" Roorkee: Nem Chand and Bros; 2009.

Focus: This course focuses on employability aligned with CO3 and CO4

Course Outcomes:

Upon successful completion of this course, the student will be able to:

- CO1: Understand the behavior of structure under the loadings.
- CO2: Discuss how the truss member performance under the loads and by how many ways we can determine the generated forces at the joints.
- CO3: Demonstrate the use of different type of arches in structure
- CO4: Analyze the behavior of bridge decking under the movable loads.
- CO5: Analyze the beams, frames and trusses by different methods.
- CO6: Analyze the indeterminate structures like beams, trusses and frames by various force and displacement methods

	POs / PSOs

CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

BCEC 0003: DESIGN OF REINFORCED CONCRETE STRUCTURE

Objective: *The objective of this course is to develop an understanding of the basic concepts of RCC design including various design philosophies and the design and analysis of various structural elements, such as beams, columns and slabs in bending and shear, using Limit State Design Method.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to various design philosophies, Design of rectangular singly and doubly reinforced sections by Working Stress Method, Limit State Method, Design and analysis of T- Beams, L-Beams by Limit State Design Method. **Behavior of RC Beam in Shear:** Shear Strength of Beams with and without shear reinforcement, Minimum and Maximum shear reinforcement, Design of beam in shear, Development Length, Anchorage Bond, Flexural Bond, Failure of Beam under Shear, Concept of Equivalent Shear and Moments.	18
II	**Design of Slab:** Design of One Way and Two Way solid slabs, Circular slab by Limit State Design Method, Serviceability, Control of Deflection, Cracking and Vibrations. Introduction to Flat Slabs. **Design of Columns:** Limit State Design Method, Effective height of columns, Minimum eccentricity, Short column under axial compression, Requirements for Reinforcement, Column with helical reinforcement, Short column under axial load and uniaxial bending, Design of columns under bi-axial loading by Design Charts.	22

Text Books:

- P. Dayaratnam Limit State Design of Reinforced Concrete Structures New Delhi: Oxford Publishers; 2008.
- M.L Gambhir Fundamentals of Reinforced Concrete Design New Delhi: PHI Publisher; 2009.
- IS: 456:2000 Plain and Reinforced Concrete - Code of Practice New Delhi: Bureau of Indian Standards.
- K. Jai Plain and Reinforced Concrete Vol.1 Roorkee: Nem Chand Brothers;2007.
- A.K. Jain Reinforced Concrete: Limit State Design Roorkee: Nem Chand and Brothers; 2007.

Reference Books:

- K. Raju Pre stressed Concrete New Delhi: Tata McGraw Hill; 2007.
- D. Menon and S. Pillai, Reinforced Concrete Design New Delhi: Tata McGraw Hill; 2007

Focus: This course focuses on employability aligned with CO2 and CO3

Outcome: After completion of course, the student will be able to:

- CO1: Understand design philosophies used for design of singly and doubly reinforced sections.
- CO2: Apply LSM for the design and analysis of RCC beams in bending.
- CO3: Examine the behavior of RCC beams in shear.
- CO4: Describe various Limit States of LSM for the design of one-way and two-way slabs.
- CO5: Determine the effective height, minimum eccentricity and reinforcement requirements for columns

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO2
CO2	PO1,PO2/PSO2
CO3	PO1,PO4/PSO2

CO4	PO1/PSO2
CO5	PO1,PO2,PO3/PSO2

BCEC 0004: DESIGN OF STEEL STRUCTURES

Objective: *To develop the ability to analyze and design steel structural members*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**General Considerations:** Introduction, Advantages and Disadvantages of Steel as a Structural Material, Structural Steel, Rolled Steel Sections, Convention for Member Axes. Various loading condition for steel structure **Simple Connections:** Riveted, Bolted and Pinned **Connections:** Introduction, Riveted Connections, Patterns of Riveted Joints, Bolted Connections, Types of Bolts, Types of Bolted Joints, Load Transfer Mechanism, Failure of Bolted Joints, Specification for Bolted Joints, Bearing-Type Connections, Tensile Strength of Plate, Efficiency of the Joint, Combined Shear and Tension	20
II	**Weld Connections:** Types, Symbols, Weld Defects, Inspection of Welds, Assumptions in the Analysis of Welded Joints, Design of Groove Welds, Design of Fillet Welds, Fillet Weld Applied to the Edge of A Plate or Section, Fillet Weld for Truss Members, Design of Intermittent Fillet Welds, Plug and Slot Welds, Stresses Due to Individual Forces, Combination of Stresses, Failure of Welds, Fillet Weld Versus Butt Weld, Welded Jointed Versus Bolted and Riveted Joints. **Tension Members:** Introduction, Types of Tension Members, Net Sectional Area, Effective Net Area, Types of Failure, Design Strength of Tension Members, Slenderness Ratio, Displacement, Design of Tension Member, Lug Angles, Splices, Gusset Plate. **Compression Members:** Introduction, Effective Length, Slenderness Ratio, Types of Sections, Types of Buckling, Classification of Cross Sections, Column Formula, Design Strength, Design of Axially Loaded Compression Members. Built-Up Columns: Latticed Columns, Battening system Beams: Introduction, Types of Sections, Behavior of Beam in Flexure, Section Classification, Lateral Stability of Beams, Lateral-Torsional Buckling, Bending Strength of Beams, Laterally Supported Beams, Laterally Unsupported Beams, Shear Strength of Beams, Web Buckling, Bearing Strength, Web Crippling, Deflection, Design Procedure of Rolled Beams, Introduction to Plate Girder, Introduction to Gantry Girder.	20

Text Books:

- S.S. Bhavikatti, "Design of Steel Structures", by Limit State Method as per IS:800-2007, NewDelhi I.K. International Pvt. Ltd, 2009.
- S.K. Duggal, "Limit State Design of Steel Structures", New Delhi, Tata McGraw Hill, 2010.

Reference Books:

- R.E. Englekirk, "Steel Structures: Controlling Behavior through Design", New Delhi, John Wiley and Sons Publishers, 1994.
- K.S. Sai Ram, "Design of Steel Structures", New Delhi, Pearson Publishers, 2010.
- N. Subramanian, "Design of Steel Structures", New Delhi, Oxford University Press, 2011.

Focus: This course focuses on employability aligned with CO4 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Analyze the steel as a structural material.
- CO2: Understand design philosophies and behavior of structural steel.
- CO3: Analyze and design Tension members, Compression members, Flexural members.
- CO4: Apply Design concepts to structural steel fabrication.
- CO5: Design steel structures as per industrial consideration.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2
CO5	PO1,PO2 PO3, PO4/PSO1, PSO2

BCEC 0005: Quantity Surveying and Estimation

Objective: *To know the importance of preparing the types of estimates under different conditions with different specifications and rate analysis. And to know the basic of contract management and valuation.*

Credits:04 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to estimates:** Purpose of estimating; Different types of estimates - their function and preparation; Building estimates: Schedule of rates, Units of measurements, units of works; Road Estimates – Volume of earthwork, Different methods, Earthwork for hill roads; Railway and canal works – Estimates for a new track railway line; earthwork in canals. **Analysis of rates**: Preparation for analysis of rates. Quantity of materials per unit rate of work, labour estimate.	22
II	**Specifications:** Necessity, types of specifications, specifications for different civil engineering materials. **Contracts:** Essentials of contracts, types of engineering contracts – advantages and disadvantages. **Tenders:** tender forms, tender documents & notices – time limits, necessity. **Valuation:** Purpose, difference between value and cost, qualifications and functions of a valuer, scrap & salvage value, sinking fund, capitalised value.	18

Text Books:

- M, Chakraborti, *Estimation costing, specifications and valuation in civil engineering* Calcutta: National Halftone Co.; 2005.
- B.N. Dutta, *Estimation and costing in civil engineering: theory and practice* New Delhi: UBS Publishers Distributors Ltd; 2006.

Reference Books:

- G.S. Birdie, - *Estimation and costing in civil engineering* 6thed. New Delhi: Dhanpat Rai Publishing co. Ltd; 2014.
- *J. Singh G. Singh, Estimating Costing and Valuation, Standard Publishers. 2018*

Focus: This course focuses on employability aligned with CO2 and CO3

Outcome: After completion of course, the student will be able to:

- CO1:Gain the ability to learn the various principles of computations related to quantity surveying.
- CO2: Calculate the quantity of materials required for civil engineering works as per specifications.
- CO3: Estimate the calculation of earthwork quantity for roads and canals.
- CO41: Analyze the rates of work quantities and labour.
- CO5: Understand the basic of contract, tender & valuation

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1, PSO2
CO2	PO1,PO2,PO3,PO4,PO5/PSO1, PSO2,PSO4
CO3	PO1,PO2,/PSO1, PSO2, PSO4
CO4	PO1,PO2,PO3,PO5/PSO1,PSO2
CO5	PO6,PO8,PO11/PSO1,PSO2,PSO3,PSO4

BCEC 0006: BUILDING MATERIALS & GEOLOGY

Objectives:

The objective of this course is

- *To define and understand concepts related Concrete technology which involves types and property of concrete and different adhesive materials and its vital use for safe, economic development for the buildings.*
- *To present the foundations of many basic Engineering tools and concepts related to Concrete technology and Civil Engineering.*

Credits:03 **L-T-P-J: 3-0-0-0**

Module No.	Contents	Teaching Hours
I	Materials Of Construction: Different construction materials, their properties, acceptance criteria. Brick, stone, lime, cement, stone gravel and sand, Iron and Aluminum -their properties and uses. Iron Carbon system-thermal and mechanical treatment of iron and its alloys. Timber-common Indian species, classification, Detection Treatment, Seasoning, Plastics, and composite materials. Water for construction. Asbestos, Glass, Tar and Bitumen products Adhesives, paints and Varnishes, Use of local materials in construction. Polymeric materials plastics, Epoxy Resin, polyurethane, Fiberglass, FRP. Non-Ferrous Metals. Copper, Zinc, Nonferrous Alloys use in construction. Geology: Earth as a planet Holistic understanding of dynamic planet 'Earth' through Astronomy, Geology, Meteorology and Oceanography. Meteorites and Asteroids Earth in the solar system - origin, size, shape, mass, density, rotational and revolution parameters and its age. Earth's magnetic field Earth's magnetic field Formation of core, mantle, crust, hydrosphere, atmosphere and biosphere Convection in Earth's core and production of its magnetic field Mechanical layering of the Earth. Plate Tectonics Concept of plate tectonics Soil Soils- processes of formation, soil profile and soil types.	15
II	Concrete Technology: Introduction, Composition of concrete, Portland cement: manufacturing process, Chemical composition, Hydration, Physical properties, Acceptance criteria, Storage, Different types of cement. Aggregate - classification, types, physical properties, grading, storage, acceptance criteria. Fresh concrete -workability, slump test, compacting factor test, segregate and bleeding, Strength of concrete, Durability of concrete. Batching, Mixing, Transportation, Placing, Compacting and curing of concrete. Mix design of concrete, Chemical admixtures, Construction quality control. Special concrete such as high strength, Lightweight, heavy weight, vacuum processed concrete, Mass concrete, high performance concrete, Pump-able concrete, Self-Compacting concrete, Air entrained concrete, Ferro cement, fiber reinforced concrete, Polymer impregnated concrete. Jet concrete. Non-destructive testing of concrete quality, NDT evaluations (for strength, durability etc.) like Rebound Hammer, UPV	15

Text Books:

- S. K. Duggal, “Building Materials”, New Age International Publishers 2019
- S. Kumar “Building Materials and construction”, Standard Publishers, 20th edition, reprint, 2015
- Dr. B. C. Punmia, Ashok kumar Jain, Arun Kumar Jain, “Building Construction”, Laxmi Publications (P) ltd., New Delhi. 2016
- S. C. Rangawala “Engineering Materials||”, Charter Publishing House, Anand, India 2017

Reference Books:

- PC Verghese, “Building Construction”, PHI. 2016
- R. Chuddy, “Construction Technology”,Vol 1&2, Longman UK. 2008
- S. Chander, “Basic Civil Engineering”, Jain Brothers.
- M S Shetty; Concrete Technology, S. Chand Publication New Delhi 2018

- P Kumar Mehta, Monteiro; Concrete Technology, Indian Concrete Institute
- A R Santhakumar; Concrete Technology, Oxford University Press 2018
- A.M.Neville; Properties of Concrete, Pearson Education 2002
- M L Gambhir; Concrete Technology, Tata McGraw Hill 2017
- IS 456-2000, IS 269-1989, IS 516-1959, IS 1786-1985, IS 1893-2002, IS 12269-1987, IS 10262-2009

Focus: This course focuses on employability aligned with CO2 and CO3

Outcomes:

At the end of the course, the students will be able to

- C01: think logically for development Concrete technology application in the field of Civil Engineering.
- C02: gain an experience in the implementation of Concrete Materials on engineering concepts which are applied in field Construction Fields.
- C03: Describe the physical characteristics of aggregates, sources and manufacturing processes for gravels, engineering properties of aggregates, and how aggregates are classified.
- C04: Describe the fieldwork and inspections necessary for successful results in concrete construction.
- C05: Understand the role of geology in the design and construction process of underground openings in rock.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3 /PSO3
CO2	PO1,PO2,PO5 /PSO3
CO3	PO1,PO2,PO5,PO5 /PSO3
CO4	PO1,PO2,PO3 /PSO3
CO5	PO1,PO2 /PSO3

BCEC 0007: CONSTRUCTION MANAGEMENT AND EQUIPMENTS

Objective: *This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high quality concrete for buildings and infrastructure*

Credits : 03 **L-T-P-J : 3-0-0-0**

Module No.	Content	Teaching Hours
I	Construction Planning: Introduction, activities involved types of project plan, work breakdown structure. Planning terminologies, Critical path method, forward and backward pass (AOA method), PERT. Project scheduling and resource leveling: Introduction to Resource allocation and leveling for unlimited resources, Contracts Estimation and Bidding Strategy: Introduction to determination of bid price.	15
II	Introduction to excavation and earthmoving equipment, Concreting equipment, Road making equipment: Types and Uses	15

Text Books:

- P.S. Gahlot, and B.M. Dhir, "Construction Planning and Management", New Delhi, New Age International (P) Ltd., Publishers,. 2007.
- P. Chandra, Project- Planning, analysis, selection, financing, implementation and review. Tata McGraw-Hill, New Delhi. 2007.
- P. Joy, Handbook of construction management. Macmillan Indian Limited, New Delhi. 2007.

Reference Books:

- G. Ritz, Total construction project management. McGraw-Hill, Singapore. 1994.
- BMPTC. BMPTC Directory of construction equipment and machinery manufactured in India. BMPTC, New Delhi. 2001.
- R. Peurifoy, C. Schexnayder, Construction planning, equipment, and methods. Tata McGraw-Hill, New Delhi. 2002.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcomes: After completion of course, the student will be able to:

- CO1: Understand the principles of project management, resource management and inventory.
- CO2: Prepare work break down plan and estimate resources requirements.
- CO3: Solve problems of resource allocation and leveling using network diagrams.
- CO4: Understand basics of procurement for works, goods, and consulting services.
- CO5: Understand about the various plant and equipment's used in construction operations

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO4
CO2	PO1,PO2/PSO4
CO3	PO1,PO2/PSO4
CO4	PO1,PO3/PSO4
CO5	PO1,PO2/PSO4

BCEC 0101: Mechanics OF FluidS

Objective: *This course includes basics of fluid behavior in its static and dynamic conditions. These are required for courses on Channel Hydraulics, Hydrology, and Water Resources Engineering besides other courses in Civil Engineering such as Environmental Engineering, Structural Engineering, Geo-Technical Engineering.*

Credits: 03 **L-T-P-J: 2-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Fluid, Rheology of Fluids, Continuum Principle, and Physical Properties of Fluids. **Fluid Statics**: Surface and Body Forces in a Fluid, Basic Equations, Piezometer and Manometer, Buoyancy, Stability of submerged and floating bodies. **Fluid Kinematics**: Methods of describing fluid motion, Types of fluid flow, Velocity field, Acceleration, Continuity equation, Velocity Potential Function & Stream function.	15
II	**Fluid Dynamics**: Momentum equation for steady flow, Momentum correction factor, Euler's equations, Bernoulli's equation and its applications, and Energy correction factor. **Dimensional Analysis**: Dimensional Analysis and its use, Buckingham's Π theorem, Determination of Π parameters and empirical relation for fluid flows, Significance of major dimensionless numbers. **Boundary Layer Theory& Viscous Flows**: Boundary layer over a flat plate, Laminar and turbulent boundary layers, Boundary layer thicknesses. Laminar flow in Circular Pipes, Stokes's Law, Frictional Head Loss & Minor losses in Circular Pipes.	15

Text Books:

- G.L. Asawa, (2009), Fluid Flow in Pipes and Channels, CBS Publishers and Distributors, New Delhi.
- V. Gupta, and S.K. Gupta, Fluid Mechanics and its Applications, New Age International (P) Limited, Publishers, New Delhi. (1984),

Reference Books:

- B.S. Massey, (revised by John Ward-Smith), Mechanics of Fluids, Chennai Micro Print Pvt ltd Chennai. 1998
- V.L. Streeter, E.B. Wylie, and K.W. Bedford, , Fluid Mechanics, McGrawHill Companies, Singapore 1998

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the fundamentals of fluid with its properties
- CO2: Determine the basic equations of fluid statics and fluid kinematics
- CO3: Calculate discharge through various flow measurement devices and pipe losses using Bernoulli's equation
- CO4: Explain similarity laws and dimensionless numbers with its law's
- CO5: Compare different types of viscous flows in pipes with its losses
- CO6: Describe boundary layer theory with its applications

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1

CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1
CO6	PO1,PO2 /PSO1

BCEC 0102: Open channel Hydraulics

Objective: *This course includes basics of open channel flow required for design of channels for any water resource project. Requirement of efficient channel section and design procedure for efficient channel section to understand the characteristics of varied flow.*

Credits: 02 **L-T-P-J: 1-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Free Surface Flow:** Types of channels, comparison between pipe and channel flows, Geometric elements of a channel section, Classification of open channel flows, basic equations governing channel hydraulics, Velocity variation in a channel section, Measurement of velocity in a channel. **Uniform Flow in Channels**: Flow resistance in channel flow, Theoretical and empirical resistance relationships for channel flows, Normal depth and its computation for different channel cross-sections. Most efficient cross-sections for rigid boundary channels. **Critical Flow in Channels**: Specific energy, Critical depth computations, Applications of critical flow concepts.	12
II	**Gradually Varied Flow**: Basic equation and its various forms for gradually varied flow (GVF), Characteristics and computation of GVF profiles in prismatic and non-prismatic channels. **Rapidly Varied Flow**: Hydraulic jump and its types, Applications of Hydraulic Jump. **Fluvial Hydraulics**: Incipient motion, Regimes of flow	08

Text Books:

- G.L. Asawa, , "*Fluid Flow in Pipes and Channels*", CBS Publishers and Distributors, New Delhi. 2009
- R.H. French, , "*Open-Channel Hydraulics*", McGraw-Hill Book Company, Singapore. 1994
- C.S.P. Ojha, R, Berndtsson, and P.N. Chandramouli, (2010), "*Fluid Mechanics and Machinery*", Oxford University Press, New Delhi.

Reference Books:

- K.G. RangaRaju, (1993), "*Flow through Open Channels*", Tata McGraw-Hill, Publishing Company Ltd., New Delhi.
- K. Subramanya, (1996), "*Flow in Open Channels*", Tata McGraw-Hill, Publishing Company Ltd., New Delhi.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: D*ifferentiate between open channel flow and pipe flow*
- CO2: *Various forces acting in open channel flow*
- CO3: *Design of efficient channel section*
- CO4: *Understand the characteristics of varied flow*
- CO5: *Uses of hydraulic jump*
- CO6: *Comprehensive study in fluvial hydraulics*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1

CO3	PO1,PO2,PO3 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1
CO6	PO1,PO2 /PSO1

BCEC 0103: WATER RESOURSE ENGINEERING

Objective: *To impart the knowledge of various aspects of water resources engineering*
Credits: 03 **L-T-P-J: 2-1-0-0**

Module No.	Content	Teaching Hours
01	**Irrigation:** Necessity of Irrigation, Benefits and ill effects of Irrigation, Methods of Irrigation, History of Irrigation development in India. **Soil-Water Plant relationship:** Soil-water relationships, Crops and Crop Seasons, Evapotranspiration (consumptive use), Command Areas and Intensity, Duty of water and Delta, Factors affecting duty and delta of water, Methods of Improving Duty, Irrigation efficiencies, And Irrigation Requirement of Crops. Canal Irrigation: Planning, alignment, and design discharge of irrigation canal systems, Delivery of water to farms, Management of canal irrigation in India. **Diversion Headwork's:** Types, location and Components of headwork's, Weir, Barrage, Design of impervious floor for subsurface flow, Bligh's Creep theory, Lane's Weighted Creep theory, Khosla's Theory, Under sluices, Divide wall, Fish ladder, Canal Head regulator, Silt Control Devices.	18
02	**Canal regulation structures:** Necessity of providing Canal falls, Distributary head regulator, Cross regulator, Sediment control measures in off taking canals. Cross-drainage structures: Types of Cross-drainage structures, Design concepts for aqueducts, siphon aqueduct, level crossing, super passage, and siphon. Canal headworks: Location and different units of headworks, Methods of river training for canal headworks.	12

Text Books:

- G.L. Asawa, "Irrigation and Water Resources Engineering", New Delhi: New Age International (P) Limited,Publishers;2005
- B.C. Punmia, "Irrigation and Water Power Engineering", New Delhi: Laxmi Publications; 1992

Reference Books:

- R.S. Varshney, "Hydropower Structures including Canal Structures and Small Hydro", Roorkee: Nem Chandand Brothers; 2001
- L.W Mays,. Water resources engineering. John Wiley & Sons. 2010

Focus: This course focuses on employability & Skill development aligned with CO4 and CO5
Outcome: After completion of course, the student will be able to:

- CO1: To impart knowledge about various components of hydrologic cycle that affect the movement of water in the earth
- CO2: Able to understand the basic requirements of irrigation and various irrigation techniques, requirements of the crops
- CO3: To impart knowledge about Distribution systems for canal irrigation and the basics of design of unlined and lined irrigation canals design
- CO4: Able to understand the basic components of river Training works.
- CO5: Apply math, science, and technology in the field of water resource Engineering.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1

CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

BCEC 0201: GEOTECHNICAL ENGINEERING

Objective: *To provide students with basic understanding of physical and mechanical properties of soil, together with knowledge of basic engineering procedures to identify factors controlling soil behavior and methods to determine soil properties. Students will be equipped with knowledge of geotechnical engineering to be used in further design and analysis of different types of foundations.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Soil Formation, Transport and Deposit of Soil, Soil Composition, Basic Definitions, Phase Relationships, Index Properties, Particle Size Analysis, Shape and Size, Grain Size Distribution Curves, Relative Density, Consistency of Soils, Determination of Important Physical and Index Properties of Soils, Soil Classification Systems with Specific Reference to Unified Soil Classification and IS Soil Classification Systems, Field Identification Tests. **Soil Structure:** Soil Structure, Single Grained Structure, Honeycomb Structure, Flocculent and Dispersed Structures, Structure of Composite Soils. Role of Soil Structure on the Behavior of Soils. **Soil-Water Relations:** Soil-Water Systems, Capillarity, Geostatic Stresses, Effective and Neutral Stress, Capillary Flow, Darcy's Law, Permeability, Factors Affecting Permeability, Determination of Permeability in the Laboratory and in the Field,	19
II	**Flow through Porous Media:** Piping, Quick Sand Condition, Seepage, Governing Differential Equation for Flow through Soils. Different Kinds of Flow: Steady State and Transient Flow, Graphical Method of Solving Steady State Flow Equation (Laplace Equation): Flow Nets and their Uses, Flow through Homogeneous Earth Dams: Two Dimensional Cases, Design of Drainage Filters. **Compaction:** General Principles, Moisture- Density Relationship, Optimum Moisture Content, Relevant Laboratory and Field Tests, Factors Affecting Compaction, Field Compaction, Compaction Techniques. **Compressibility And Consolidation:** Fundamentals, 1-D Consolidation, Normally and Over-Consolidated Clays, Void Ratio-Pressure Relationships, Determination of Pre-Consolidation Pressure, Compressibility Characteristics, Terzaghi's One Dimensional Consolidation Theory and Coefficient of Consolidation, Time Rate of Consolidation, Determination of Coefficient of Consolidation in the Laboratory: Curve Fitting Techniques, Primary and Secondary Consolidation and Settlement, Settlement Analysis, 3-D Consolidation, Vertical Sand Drains **Shear Strength Of Soil:** Mohr-Coulomb Failure Criterion, Direct Shear Test, Unconfined Compression Test, Triaxial Tests: Unconsolidated Undrained, Consolidated Drained and Consolidated Undrained Tests, Vane Shear Test, Shear Strength Of Clays, Critical Void Ratio, Pore-Pressure Coefficients.	21

Text Books:

- K.R Arora "*Soil Mechanics & Foundation Engineering*" New Delhi: Standard Publishers Distributors; 2009.
- G. Ranjan and Rao A.S.R. "*Basic and Applied Soil Mechanics*" New Delhi: New Age Publication; 2000.
- C. Venkataramaiah "*Geotechnical Engineering*" New Delhi: New Age Publications; 2006.

Reference Books:

- V.N.S. Murthy "*Soil Mechanics and Foundation Engineering*" New Delhi: Marcel Dekker Publications; 2010.
- R.F. Craig "*Soil Mechanics*" US: Spon Publications; 1997.
- J.N. Cernica *"Geotechnical Engineering*" Holt, Reignhart & Winston; 1982.

Focus: This course focuses on employability & Skill development aligned with CO1 and CO4

Course Outcome: After completion of this course, student will be able to:

- CO1: Understand the basic properties and structure of soil
- CO2: Learn the relationship between soil and water and its effect on effective stress of soil
- CO3: Apply the concept learned to obtain effect of seepage on hydraulic structures
- CO4: Learn the concept of soil compaction and evaluate the consolidation of soil
- CO5: Understand the shear behavior of soil

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO12/ PSO3
CO2	PO1, PO2, PO4, PO12/ PSO3
CO3	PO1, PO2, PO3, PO4, PO12 / PSO3
CO4	PO1, PO2, PO3, PO4PO5, PO12 / PSO3
CO5	PO1, PO2, PO3, PO4, PO5, PO12 / PSO3

BCEC 0301: TRANSPORTATION ENGINEERING

Objective: *To impart the knowledge of highway design, construction and maintenance.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Highway Development and Planning:** Role of Transportation, Modes of Transportation, History of Road Development, Nagpur Road Plan, Bombay Road Plan and Lucknow Road Plan, Road Plan 2021, Road Patterns. **Highway Geometric Design:** Cross Sectional Elements: Design Factors, Carriageway, Camber, Shoulder, Sight Distances, Horizontal Curves, Super Elevation, Extra Widening, Transition Curves and gradient, Vertical curves. **Traffic Engineering:** Traffic Characteristic, Volume Studies, Speed Study, Capacity, Density, Traffic Control Devices: Road Markings, Signs, Signals, Design of Signals, Island, Intersection at Grade and Grade Separated Intersections, Design of Rotary Intersection.	20
II	**Design of Highway Pavements:** Types of Pavements, Design Factors, Design of Flexible Pavement by CBR Method (IRC: 37-2001 and IRC: 37-2012), Design of Rigid Pavement, Westergaard Theory, Load and Temperature Stresses, Joints, IRC Method of Rigid Pavement Design (IRC: 58 – 2011). **Highway Materials:** Tar, Asphalt, Bitumen and Test on Bitumen, Aggregates and their Testing, new highway material, modified binders, PMB, CRMB, Anti-stripping compound (HindCol, Super Bond, Tiki Tar), RBI- Garde 81, Micro surfacing, SMA (Stone matrix asphalt), Super Pave Technology. **Highway Construction:** Road Construction Methods, Water Bound Macadam, Surface Dressing, Bituminous Carpeting, Bituminous Bound Macadam and Asphaltic Concrete, Cement Concrete Road Construction. **Highway Maintenance:** Various Type of Failures, Evaluation and Remedial Measures, Overlay Design- Benkleman Beam.	20

Text Books:

- S.K Khanna. and C.E.G. Justo *Highway Engineering*Roorkee:Nem Chand and Brothers; 2011.

Reference Books:

- P. Chakroborty and A. Das *Principles of Transportation Engineering*,New Delhi: PHI Learning Publications 2009.
- L.R. Kadiyali and N.B. Lall 2009, *Highway Engineering* New Delhi:Khanna Publishers; 2009.
- L.R. Kadiyali *Traffic Engineering and Transportation Planning* New Delhi:Khanna Publishers; (2011).
- C.J. Khisty and B.K. Lall *Transportation Engineering: An Introduction* New Delhi:PHI Learning Publications 2009.
- C.S. Papacostas and P.D. Prevedouros *Transportation Engineering and Planning* New Delhi: PHI Learning Publications; 2009.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the role of highway development and planning in nation building.
- CO2: Describe highway geometric design parameters.
- CO3: Describetraffic characteristics, traffic surveys, traffic control devices and use of Materials in highway construction.
- CO4: Design of highway pavements based upon latest IRC code (IRC 37 and IRC 58).
- CO5: Evaluate the pavement for maintenance and recommend required remedy to it.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO6, PO7, PO12 / PSO4

CO2	PO1, PO2, PO12 / PSO4
CO3	PO1, PO1, PO2, PO3, PO4 / PSO4
CO4	PO1, PO2, PO3, PO6, PO12 / PSO4
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12/ PSO4

BCEC 0401: ENVIRONMENTAL ENGINEERING

Objective: *To Learn water supply and waste water management process*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction and Scope, Water Demand for Domestic Use, Factors Affecting Water Consumption, Design Periods, Population Forecasting Methods. **Sources of Water**: Kinds of Water Sources and Their Characteristics, Collection and Quality of Surface and Ground Water, Factors Governing the Selection of a Source of Water Supply, Intakes and Their Design for Lakes, Streams, Canals and Rivers, Impounding Reservoir and Determination of Its Capacity. **Wastewater Collection:** Types of Sewers, Flow in Full and Partially Full Sewers, Design of Sewers, Types, Materials, and Construction of Sewers, Joints and Sewer Appurtenances, Layout and Construction of Sewer Lines, Planning of Sewerage Systems, Construction & Maintenance, Storm water Sewers. **Water & Wastewater Characteristics**: Physical, Chemical, and Bacteriological Examination of Water & Wastewater, Indian and Global Standards of Water Quality. Effluent Standards. **Water Treatment:** Conventional Surface Water Treatment Using Coagulation, Flocculation, Settling, Filtration and Disinfection, Domestic Water Purifiers.	20
II	**Wastewater Treatment:** On Site and Centralized Treatment Systems, Septic Tank, Soakage Pit and Dispersion Trench. **Pre-and Primary Treatment:** Screens, Grit Removal, Primary Settling. **Secondary Treatment:** Theory of Organic Matter Removal, Aerobic and Anaerobic Treatment Processes, Activated Sludge Process, Conventional and Extended Aeration Systems, Trickling Filters, Aerated Lagoons, Waste Stabilization Ponds, Oxidation Ditches, R.B.C., Up-Flow Anaerobic Sludge Blanket (USAB) Process. MBBR Technique. **Tertiary/ Advanced Wastewater Treatment Processes:** Removal of Nitrogen and Phosphorus. **Sludge Management**: Thickening of Sludge, Anaerobic Digestion of Sludge, Sludge Drying and Final Disposal. **Transmission of Water**: Various Types of Conduits, Laying and Testing of Water Supply Pipelines, Pipe Materials, Joints, Appurtenances and Valves, Leakages and Control, Boosters, Safety and Relief Measures, Water Hammer and Its Control Measures. **Storage and Distribution of Water**: Methods of Distribution, Pressure and Gravity Distribution Systems, Concept of Service and Balancing Reservoirs, Capacity of Distribution Reservoirs, Hardy-Cross Methods of Pipe Network Analysis. **Disposal of Wastewater**: Standards of Wastewater Disposal, Disposal of Treated Sewage on Land and in Surface Waters, Do Sag Curve	20

Text Books:

- S.K. Garg *Water Supply Engineering (Environmental Engineering Vol.-I)*New Delhi: Khanna Publisher; 2008.
- S.K. Garg *Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol.-II)* New Delhi: Khanna Publishers; 2008

Reference Books:

- M. L. Davis and D. A. Cornwell "*Introduction to Environmental Engineering*", 4th Edition, Boston: McGraw-Hill; 2008.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand the sources and characterization of drinking water
- CO2: Develop basic know about the transmission, storage and distribution of water
- CO3: Understand the Different aspects of Waste water collection, transportation and treatment
- CO4: Understand key current environmental problems
- CO5: Emphasize the need for sludge separation, thickening and volume reduction.
- CO6: Describe the design criteria for the suspended and attached growth biological wastewater

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1
CO6	PO1,PO2 /PSO1

BCEC 0800: FLUID MECHANICS LABORATORY

Objective: *To enrich the concept of fluid mechanics. Demonstrate the classical experiments in fluid mechanics. At present it is equipped with hydraulic equipment's to carry out experiments like determination of Metacentric height of a floating vessel, verification of the Bernoulli's energy equation, study of transition from laminar to turbulent flow, determination of coefficient of discharge for obstruction flow meter (venturi meter/orifice meter). Correlate various flow measuring devices such as Venturi meter, orifice meter and notches etc.*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I	• Surface Tension of a Liquid • Met centric Height of a Ship Model • Verification of The Bernoulli's Equation • Verification of The Momentum Principle • Coefficients of Discharge, Velocity, and Contraction for an Orifice. • Coefficient of Discharge of a Orifice Meter or Venture Meter • Stokes' Law • Transition from Laminar to Turbulent Flow • Velocity Distribution in A Pipe • Frictional Head Loss for Commercial Pipes	**20**

Text Books:

- G.L. Asawa, Fluid Flow in Pipes and Channels, CBS Publishers and Distributors, New Delhi. 2009

Reference Books:

- G.L. Asawa, "*Laboratory Work in Hydraulic Engineering*", New Age International (P) Limited, Publishers, New Delhi 2006
- Streeter, V.L., Wylie, E.B., and Bedford, K.W. Fluid Mechanics, McGraw Hill Companies, Singapore 1998d

Focus: This course focuses on employability & Skill development aligned with CO3 and CO1

Outcome: After completion of course, the student will be able to:

- CO1: *Learn the basic properties of fluid*
- CO2: *Understand the engineering applications involving fluid*
- CO3: *Calculate discharge through various flow measurement devices and pipe losses using Bernoulli's equation*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1

BCEC 0802: STRUCTURAL ANALYSIS LABORATORY

Objective:

- To introduce the students to the concept of theory of structural analysis and methods in structural analysis.
- Ability to analyze statically determinate and indeterminate structures

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Contents	Teaching Hours
I/II	• To determine Flexural Rigidity (EI) of a given beam • To verify Maxwell's Reciprocal theorem. • To find horizontal thrust in a three-hinged arch and to draw influence line diagrams for Horizontal Thrust end Bending moment. • To find horizontal thrust in a two hinged arch and to draw influence line diagrams for horizontal Thrust and bending moment. • To find deflection of curved members. • To find bar forces in a three members structural frames with pin jointed bar • To find Critical load in Struts with different end conditions. • To find deflections in Beam having unsymmetrical bending.	**20**

Reference Books:

- R. C. Hibbeler "Structural Analysis" 9TH ed. Noida: Pearson Education; 2014.
- N.K. Raju; Prestressed Concrete; Tata McGraw-Hill Education 2018.

Focus: This course focuses on Skill development aligned with CO2 and CO4

Course Outcomes: Upon successful completion of this course, the student will be able to:

- CO1: Distinguish between statically determinate and indeterminate structures.
- CO2: Apply equations of equilibrium to structures and compute the reactions
- CO3: Draw the shearing force and bending moment diagrams
- CO4: Calculate the internal forces in cable and arch type structures
- CO5: Evaluate and draw the influence lines for reactions, shears, and bending moments in beams and girders due to moving loads.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

BCEC 0803: STRUCTURAL DETAILING LABORATORY

Objective: *The objective of this laboratory is to enable the learners to draw the working drawings of various structural elements using drafting software and detailing of buildings and water tanks for earthquake loadings.*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Contents	Teaching Hours
I/II	Preparation of working drawings for the following using any drafting software • Slabs. • RC Beams- Simply supported, Continuous, Cantilever • T – beam / L-beam floor • Slabs – Simply supported, Continuous, One way and 2- way slabs. • Columns – Tied Columns and Spirally reinforced columns without eccentricity. • Columns – Tied Columns and Spirally reinforced columns with eccentricity • Isolated footings for RC Columns. • Combined rectangular and trapezoidal footings. • Detailing of Buildings with respect to Earthquake Resistant Design • Detailing of Rectangular Water tank resting on ground • Detailing of Circular Water tank resting on ground • Detailing of Flat Slab	20

Reference Books

- G. Omura Mastering AUTOCAD: John Wiley & Sons; 2012.
- Shaw, Kale and Patki Building Drawing with an Integrated Approach to Built Environment: McGraw Hill; 2002.
- A. Jefferis & K. D Smith Commercial Drafting and Detailing: Cengage Learning; 2010.
- Karve S.R Design of reinforced concrete buildings; 2010.
- K. Raju N Structural Design and Drawing Hyderabad: University Press (India), Pvt. Ltd; 2005.

Focus: This course focuses on Skill development aligned with CO3 and CO5

Course Outcomes:

- Understand about the alignment of reinforcement in different building elements
- Describe the codal provision for the provision of diameter of reinforcement bars and spacing
- Learn to read the detail drawing of a building plan
- Prepare a working drawing for beam, column, slab, staircase, balcony for a 3BHK building etc.
- Draw and detail the water tanks resting on ground

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO5 /PSO2
CO2	PO1,PO5/PSO2
CO3	PO1,PO5/PSO2
CO4	PO1,PO5/PSO2
CO5	PO1,PO5/PSO2

BCEC 0804: CAD LABORATORY

Objective: To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design, analysis of building and Computer Aided Engineering Analysis.

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I	1. Introduction on various softwares for analysis and design of structures 2. Analysis of simple beam with different loading and support conditions 3. Analysis of simple column with different loading and support conditions. 4. Analysis of simple steel frame with different loading and support conditions. Analysis and design of RCC Slab. 5. G+3 RC and steel building modeling. 6. Analysis of G+3 RC building without earthquake load. 7. Analysis of G+3 RC building with earthquake load. 8. Analysis of G+3 steel building without earthquake load. 9. Analysis of G+3 steel building with earthquake load. 10. Analysis of Circular Water Tank. 11. Analysis of Staircase	20

Text Books

- P. Gunthar, An Introduction to Excel for Civil Engineers, Createspace Independent Pub; 2016.
- B. Held, Excel Functions and Formulas, BPB Publications; 2015.
- S. Tickoo, Learning Bentley Staad. Pro V8I for Structural Analysis, Dreamtech Press; 2015.

Reference Books:

- S. Tickoo, Exploring Bentley STAAD.Pro V8i, BPBPublications; 2015.
- Staad Pro V8i, Technical Reference Manual.

Focus: This course focuses on employability & Skill development aligned with CO1

Outcome: After completion of course, the student will be able to:

CO1: In this lab, students will be able to learn abilities and capabilities in developing and applying computer software and hardware to civil-structural design.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO3/PSO1,PS03

BCEC 0807: TRANSPORTATION ENGINEERING LABORATORY

Objective: *To impart knowledge of testing of highway material in laboratory and to interpret results.*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I/II	**Tests on aggregate** • Crushing Value. • Los Angeles Abrasion Value • Aggregate Impact Value. • Flakiness Index and Elongation Index of Aggregate. • Soundness Test. **Tests on bitumen** • Penetration Value of Bitumen. • Softening Point Value. • Ductility Value. • Flash and Fire Point of Bitumen. • Specific Gravity of Bitumen. • Stripping Test of Bituminous Sample. • Viscosity test of Bitumen.	20

Text Books:

- Khanna, S.K. and Justo, C.E.G..*Highway Material Testing Laboratory Manual*, Nem Chand and Brothers, Roorkee; 2010.

Focus: This course focuses on Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the significance of laboratory tests performed on highway materials
- CO2: Study about the desired properties of highway materials
- CO3: Study and perform various lab tests procedures and safety precautions to be taken care of while performing tests
- CO4: Interpret the lab results keeping in mind the real life scenarios

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6, PO9, PO12 /PSO4
CO2	PO1, PO6, PO9, PO12 /PSO4
CO3	PO1, PO6, PO9, PO12 /PSO4
CO4	PO1, PO6, PO9, PO12 /PSO4

BCEC 0808: ENVIRONMENTAL ENGINEERING LABORATORY

Objective: *To learn different laboratory experiment of Water and waste water analysis*
Credits: 01 **L-T-P-J :0-0-2-0**

Module No.	Content	Teaching Hours
	• Determination of Turbidity • Determination of pH. • Determination of Hardness. • Determination of Residual Chlorine • Determination of Most Probable Number of Coli forms • Measurement of Air Pollutants with High Volume Sampler • Determination of Total Suspended and Dissolved Solids • Determination of BOD • Determination of COD • Determination of Kjeldahl Nitrogen • Determination of Fluoride • Determination of Conductivity • Determination of Chlorides • Determination of Alkalinity and Acidity • Determination of Dissolved Oxygen	20

Text Books:

- Garg S. K. "*Water Supply Engineering*" [Vol. I & II]NewDelhi: Khanna Publishers; 2008.

Reference Books:

- Davis M. L. and Cornwell D. A. "*Introduction to Environmental Engineering*" 4th Ed. Boston: McGraw-Hill; 2008.
- Garg S. K. "*Water Supply Engineering*" [Vol. I & II]NewDelhi: Khanna Publishers; 2008.

Focus: This course focuses on Skill development aligned with CO1 and CO2
Outcome: After completion of course, the student will be able to:

- CO1: Understand the sources of water and characterization of water including
- CO2: Physical, chemical and biological water quality parameters.
- CO3: Develop basic know about the transmission, storage and distribution of water.
- CO4: Understand the Different aspects of Waste water characterization, transportation and Planning
- CO5: Understand the basics of Waste water treatment process and its Design.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 /PSO1
CO3	PO1, PO2 /PSO1
CO4	PO1, PO2 /PSO1
CO5	PO1, PO2 /PSO1

BCEC 0811: CHANNEL HYDRAULICS LABORATORY

Objective: *To determine the various parameters related to fluid flow in channels, investigate the uniform flow condition in open channel flow and to verify the manning's equation. Develop skills for analyzing experimental data and working in teams.*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I	• Uniform Flow in a Channel • Velocity Distribution in a Channel • Vertical Contraction in a Channel • Horizontal Contraction in a Channel • Hydraulic Jump in a Channel • Coefficient of Discharge of a Triangular/Rectangular Sharp-Crested Weir • Submerged Hydraulic Jump • Broad crested weir	20

Text Books:

- Asawa, G.L., Fluid Flow in Pipes and Channels, CBS Publishers and Distributors, New Delhi; 2009.

Reference Books:

- Asawa, G.L., "*Laboratory Work in Hydraulic Engineering*", New Age International (P) Limited, Publishers, New Delhi; 2006.

Focus: This course focuses on Skill development aligned with CO3 and CO1

Outcome: After completion of course, the student will be able to:

- CO1:*Understand the nature of velocity distribution in a channel*
- CO2:*Differentiate between uniform flow and non-uniform flow*
- CO3:*Determination of discharge in vertical contraction and horizontal contraction of a channel*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 /PSO1
CO3	PO1, PO2 /PSO1

BCEC-0001: ADVANCED DESIGN OF STEEL STRUCTURES

Objective: The objective of this course is to develop the ability to analyze and design steel structures of advanced level like transmission Towers, Industrial Sheds, etc.

Credits: 04 **L-T-P-J: 4-1-0-0**

Module No.	Content	Teaching Hours
I	Introduction to the use of light gauge steel sections with application to flat slab, grid and orthotropic plates. Design of Aluminum structures. Design of transmission line towers, concept of TV and guyed towers. Buckling of steel columns.	20
II	Beam column and their designs. Rigid, Semi-Rigid and Flexible connections. Plastic methods of Structural Analysis of frames. Design of Industrial trussed bents. Pressed steel construction	20

Reference Books:

- 1. Design of steel structures- Bresler Lin &Scalzi(2000).
- 2. Steel building analysis and design- Crawley &Dhillon(1993).
- 3. Design of steel structures- S. K. Duggal(2010).
- 4. Design of steel structures- Arya&Ajmani(1972).

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Design advanced steel structures as per industrial consideration.
- CO1: Analyze and design of Aluminum Structures
- CO2: Developing the understanding of fundamentals of design of Light Gauge Steel.
- CO3: Analyze Structural frames Using Plastic methods.
- CO4: Design of Industrial trussed bents. Pressed steel construction

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2
CO5	PO1,PO2 PO3, PO4/PSO1, PSO2

BCEE 0002: BRIDGE ENGINEERING

Objective: *To impart knowledge on important types of bridge structures, their selection and planning, structural configurations, assessment of loads and perform design.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** History of Bridges; Components of a Bridge and its definitions; Classification of Road Bridges, related structures, span length, Classical Examples of each type; Selection of Site and Initial Decision Process, Survey and Alignment; Geotechnical Investigations and Interpretations. **River Bridge:** Selection of Bridge site and planning; Collection of Bridge design data; Hydrological calculation; Waterway calculation; Scour calculation; Depth of foundation; Freeboard. **Road Bridge**: Selection of Bridge site and planning; Collection of Bridge design data; Vertical clearance; Standard Loading for Bridge Design as per different codes: IRC, BS code, AASHTO code. Dead load, Live load, Impact factor, Centrifugal force, Wind loads, hydraulic forces, Longitudinal forces, Seismic forces; Earth pressure; Buoyancy; Lane concept, equivalent loads, traffic load; Width of Roadway and Footway; Influence lines for statically; determinate structures. I.L. for statically indeterminate structures; Transverse distribution of Live loads among deck longitudinal; Load combinations for different working state and limit state designs; Railway Bridges; Loadings for Railway Bridges; Railroad data; Pre-design considerations; Railroad vs. Highway bridges; Box Girder Bridge (Straight/ Skew). **Superstructures:** Selection of main bridge parameters, design methodologies; Choices of superstructure types; Orthotropic plate theory, load distribution techniques; Grillage analysis; Finite element analysis (Preferable); Different types of superstructure (RCC and PSC);	20
II	**Longitudinal Analysis of Bridge:** Slab bridge and voided slab bridge; Beam-Slab bridge; Box Girder Bridge. **Transverse Analysis of Bridge:** Slab bridge and voided slab bridge; Beam-Slab bridge; Box Girder Bridge; Temperature Analysis; Distortional Analysis; Effects of Differential settlement of supports; Reinforced earth structures; Typical Details: Slab Bridge; Slab-Girder Bridge (Straight/Skew). **Substructure:** Pier; Abutment; Wing walls; Importance of Soil-Structure Interaction; Types of foundations; Open foundation; Pile foundation; Well foundation; Examples - Simply supported bridge, Continuous Bridge; Bearings and Deck Joints: Different types of bridge bearings and expansion joints; Design of bearings and joints; Parapets and Railings for Highway Bridges: Definitions; Classification of Highway Bridge parapets.	20

Text Books:

- Jagadish T.R. & M.A. Jayaram, "Design of Bridge Structures",2nd Edition;2009
- J. victor D, "Essentials of Bridge Engineering", 7th Edition, Oxford, IBH publishing Co.,Ltd;2006.
- N.K. Raju " Prestressed Concrete Bridges" CBS Publishers;2012.

Reference Books:

- Krishna Raju N., “Design of Bridges”, 4th Edition, Oxford and IBH Publishing Co., Ltd., 2008
- PonnuSwamy, “Bridge Engineering”, 4th Edition, McGraw-Hill Publication, 2008.
- Swami Saran, “Analysis and Design of sub-structures”,2nd Edition, Oxford IBH Publishing co ltd., 2006.
- Vazirani, Ratvani&Aswani, “Design of Concrete Bridges”,5th Edition, Khanna Publishers, 2006.

Focus: This course focuses on employability aligned with CO4 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand about components, classifications and choice of bridge type along with the investigation for bridges in detail.
- CO2: Recognize various types of sub-structures and foundations, bearing, joints and appurtenances required for bridges.
- CO3: Implement various standard specifications for road bridges
- CO4: Eatimaterespences of Single and Multi Degree of Freedom System
- CO5: Analyze R.C.C. and steel bridge and their types also.
- CO6: Able to learn about methods of construction and maintenance of bridges along with causes of bridge failure

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

BCEE 0003: Advanced Design of Concrete Structure

Objective:

The subject aims to develop an understanding of design and detailing of domes, beams curved in plan, various types of combined footings. Subject also covers the design concepts of water retaining and earth retaining structures.

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	Nature of Stresses in flat slabs with and without drops, coefficient for design of flat slabs, reinforcement in flat slabs. (IS Code Method). Analysis and design of beam curved in plan. Structural behavior of footings, design of footing for a wall and a single column, combined rectangular and trapezoidal footings, Design of strap footing. Structural behavior of retaining wall, stability of retaining wall against overturning and sliding, Design of T-shaped retaining wall, Concept of Counter fort retaining wall	20
II	Loads, forces and I.R.C. bridge loadings, Design of R.C. slab culvert. Design criteria, material specifications and permissible stresses for tanks, design concept, of circular and rectangular tanks situated on the ground / underground, design of overhead tanks. Concept of pre-stressed concrete, Methods of pre-stressing: pre-tensioning and post-tensioning, Advantages and disadvantages of pre-stressing, Losses in pre-stress	20

Text Books:

- IS : 456 – 2000, " Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi; 2004.
- Jain, A.K., "Reinforced Concrete : Limit State Design", Nem Chand & Bros., Roorkee; 2012.
- Dayaratnam, P, "Limit State Design of Reinforced Concrete Structures" Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi; 2017.
- Jain, O. P. & J. Krishna, " Plain and Reinforced Concrete", Vol. I & II, Nem Chand & Bros., Rookee; 2007.
- Park, R. and T. Pauley," Reinforced Concrete Structures", John Wiley & Sons; 1975.

Reference Books:

- Gambhir, M L ,"Fundamentals of Reinforced Concrete", Prentice Hall of India; 2010.
- U. Pillai, S. & D. Menon, " Reinforced Concrete Design", Tata Mc-Graw Hill Company Limited;2017.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Analyze and Design the flat slab
- CO2: Analyze and design of beams curved in plan
- CO3: Analyze and design of retaining wall
- CO4: Analyze and design of culvert
- CO5: Understand the concept of prestress

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs

CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO5

BCEE 0004: MATRIX ANALYSIS OF STRUCTURES

Objective:

- *Learn the fundamental concepts of matrix structural mechanics, such as the stiffness method.*
- *The concepts of structural analysis learnt in mechanics of solids and structures course.*
- *Understanding the analysis of statically determinate and indeterminate structures such as trusses, beams, frames and plane stress problems.*
- *Learn the concepts of the stiffness method and apply it to a variety of structural problems involving trusses, beams, frames, and plane stress*

Credits:04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction of Matrix methods of analysis** – Properties of Matrices, singular matrix, Rank of a Matrix and Rank deficiency- Static indeterminacy and Kinematic indeterminacy – Degree of freedom – Structure idealization-stiffness and flexibility methods – Suitability Generation Element stiffness matrix for truss element, beam element and torsional element- Element force – displacement equations. **Stiffness method for beam Elements** – Element and global stiffness equation – coordinate transformation and global assembly – structure stiffness matrix equation – analysis of continuous beams	20
II	**Stiffness method for plane trusses and Grid elements** – development of stiffness matrix – coordinate transformation. Examples of pin jointed trusses and simple grid problems. **Space trusses and frames** – Member stiffness for space truss and space frame– Transformation matrix from Local to Global – Analysis of simple trusses, beams and frames.	20

Text Books:

- Asslam,K.,“*MatrixAnalysisofStructures*”,Brooks/ColePublishingCo.,USA; 1999.
- Hibbeler,R.C.,“*StructuralAnalysis*”,PearsonEducationPublishers,NewDelhi; 2008.
- Jain,A.K.,“*TheoryandAnalysisofStructures*”,Vol.IandII,NemChandandBrothers,NewDelhi; 2009.
- Menon,D.,“*AdvancedStructuralAnalysis*”,NarosaPublishingHouse,NewDelhi;2009.

Reference Books:

- Reddy, C.S., “*Basic Structural Analysis*”, Tata McGraw Hill, NewDelhi; 2005.
- Vazirani,V.N.andRatwani,“*M.M.AnalysisofStructures:Theory&Design,Vol.1and2*”,17thedition,KhannaPublishers,NewDelhi; 1994.
- Weaver, W. and Gere,J.M.,“*MatrixAnalysisofFramedStructures*”,CBSPublishers,NewDelhi; 2004.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Analyse framed structures using flexibility and stiffness method.
- CO2: Calculate deflections, reactions, internal forces of trusses, beams and frames using matrix methods
- CO3: Develop computer programs for analysis of framed structure.
- CO4: Explain Internal forces due to thermal expansion and lack of fit, Application to symmetrical structures using displacement method

- CO5: Comparison between stiffness and flexibility methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4

BCEE 0005: PLASTIC ANALYSIS OF STRUCTURE

Objectives: *Plastic analysis derives from a simple mode failure in which plastic hinges form actually the ultimate load is found from the strength of steel in plastic range. This method of analysis is quite rapid and has rational approach for analysis of structure.*

Credits:04 **L-T-P-J: 3-1-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction**: Historical Review, Plastic Failure, Plastic Moment, Capacity of a Cross-Section, Shape Factor, Concept of Load Factor, Plastic Hinge and Collapse Mechanisms, Analysis of Beams and Frames, Moment Curvature Relationships for Rectangular and I-Section. Basic Theorems: Uniqueness, Lower Bound and Upper Bound, Static Method and Mechanism Method for Collapse Load Analysis,	20
II	Plastic Moment Distribution for Beams, Portals, Multi-Storey and Multi-Bay Frames. **Deflection At Collapse**: Analysis for Deflections at Collapse, Effect of Axial Force and Shear on Plastic Moment Capacity or Rectangular and I-Section.	20

Text Books:

- B. Wong, M. "Plastic Analysis and Design of Steel Structures" New York, USA: Butterworth-Heinemann Publishers; 2008.
- Hodge, P.G. "*Plastic Analysis of Structures*" New York USA: McGraw Hill Book Company; 1998.

Reference Books:

- Jirasek, M. and Bazant, Z.P. "Inelastic Analysis of Structures" New York USA: John Wiley and Sons Limited; 2002.
- Neal, B.G. "Plastic Methods of Structural Analysis" New York, USA: John Wiley and Sons Limited; 2008.

Focus: This course focuses on employability aligned with CO2 and CO1

Outcome:

Upon successful completion of this course, the student will be able to:

- Understand the micromechanical behavior of plasticity and fracture mechanism of steel.
- Interpret the difference between elastic and plastic behavior of structural members.
- Differentiate the yield mechanisms and ultimate strength of structures.
- Analyze deflection in Plastic beams and frames, Load deflection relations for simple structures.
- Design structures by plastic method.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,

CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

BCEE 0007: INTRODUCTION TO EARTHQUAKE ENGINEERING

Objective: *To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.*

Credits:03 **L-T-P-J: 3-0-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Dynamic Loads:** Introduction to Dynamic Loads Static Load v/s Dynamic Load, Types of Dynamic forces, Force Control and Displacement Control **Basics of Seismology:** Earth and its interior, Plate Tectonics, Convection Currents, The Earth quake, Inter Plate Earthquake (Convergent Boundaries, Divergent Boundaries and Transform Boundaries), Intra Plate Earthquake (Faults and Types of Faults), Seismic Waves, Basic Terminology, Measuring Units and Instruments **Fundamentals of Earthquake Vibrations of Structures:** Equation of Motion (By Newton's Law and By D'Alembert's Principle),	15
II	Degrees of Freedom, Simplified Single Degree of Freedom, Mathematical Modeling, Equation of Motion for Free Vibration for Damped and Un damped System (Single Degree of Freedom System), Equation of Motion for Forced Vibration for Damped and Un damped System(Single Degree of Freedom System), Logarithmic Decrement **Earthquake Load Analysis on Structures:** Introduction to methods of Earthquake Load Analysis (Linear Static, Linear Dynamic, Non Linear Static, Non Linear Dynamic) Analysis of Structure by Linear Static Method (Seismic Coefficient Method) Analysis of Structure by Linear Dynamic Method (Random Response Method)	15

Text Books:

- Agarwal, P. and Shrikhande, M., Earthquake Resistant of Design of Structures, PHI Publications; 2007.
- Biggs, J.M., Introduction to Structural Dynamics, McGraw Hill Publications, New York, USA; 2004.
- Chopra, A.K., Dynamics of Structures, Pearson Education, New Delhi;2004.
- Duggal, S.K., Earthquake Resistant of Design of Structures, Oxford University Press, New Delhi; 2008.
- IS: 1983, Criterion for Earthquake Resistant Design, Bureau of Indian Standards, New Delhi; 1984.
- Paz, M., Structural Dynamics - Theory and Computation, Springer, New York, USA;1997.

Reference Books:

- Duggal, S.K., Earthquake Resistant of Design of Structures, Oxford University Press, New Delhi;2008.
- IS: 1983, Criterion for Earthquake Resistant Design, Bureau of Indian Standards, New Delhi;1984.
- Paz, M., Structural Dynamics - Theory and Computation, Springer, New York, USA;1997.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome:

Upon successful completion of this course, the student will be able to:

- CO1: To understand the Earthquake Engineering concepts which are applied in field Structural Engineering
- CO2: The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.
- CO3: To implement a coherent development to the students for the courses in sector of earthquake engineering

- CO4: To gain the experience in the implementation of engineering concepts which are applied in field of earthquake engineering
- CO5: To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

BCEE 0008: CONSTRUCTION ENGINEERING

Objective: *To recognizing the good building materials for construction work.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Cement:** Portland cement, chemical composition, Hydration, Setting of cement, Structure of hydrate cement, Test on physical properties, Different grades of cement. **Admixtures:** Types of admixtures, mineral and chemical admixtures. **Aggregates:** Classification of aggregate, Particle shape & texture, strength & other mechanical properties of aggregate, Specific gravity, Bulk density, porosity, adsorption & moisture content of aggregate, Bulking of sand, Deleterious substance in aggregate, Soundness of aggregate, Alkali aggregate reaction, Thermal properties, Sieve analysis, Fineness modulus Grading curves, Grading of fine & coarse Aggregates, Gap graded aggregate, Maximum aggregate size. **Fresh Concrete:** Workability, Factors affecting workability, Measurement of workability by different tests, Setting times of concrete, Effect of time and temperature on workability, Segregation & bleeding, Mixing and vibration of concrete, Steps in manufacture of concrete, Quality of mixing water.	15
II	**Hardened Concrete :** Water / Cement ratio, Abram's Law, Gels pace ratio, Nature of strength of concrete, Maturity concept, Strength in tension & compression, Factors affecting strength, Relation between compressive & tensile strength, Curing. Testing Of Hardened Concrete: Compression tests, Tension tests, Flexure tests, Splitting tests, Pull-out test. **Non-destructive testing methods:** codal provisions for NDT. Elasticity, Creep & Shrinkage, Modulus of elasticity, Dynamic modulus of elasticity, Poisson's ratio, Creep of concrete, Factors influencing creep, Relation between creep & time, Nature of creep, Effects of creep, Shrinkage: types of shrinkage. **Mix Design:** Factors in the choice of mix proportions, Durability of concrete, Quality Control of concrete, Statistical methods, Acceptance criteria, Proportioning of concrete mixes by– BIS method and ACI mix design.	15

Text Books:

- M. Neville *Properties of Concrete* 5th ed. Noida UP: Pearson Education Ltd; 2016.
- M. S. Shetty *Concrete Technology* New Delhi: S. Chand & Co; 2004.
- Job Thomas *Concrete Technology* Delhi: Cengage learning India Pvt Ltd; 2015.

Reference Books:

- M.L. Gambhir. *Concrete Technology* 3rd ed. New Delhi: Tata Mc. Graw Hill Publishers; 2006.
- P. K. Mehta and J. M. Monteiro *Concrete: Micro structure, Properties and Materials 4th* ed. Noida UP: McGraw Hill Publishers; 2014.

Focus: This course focuses on employability & Skill development aligned with CO4 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand the behavior of fresh and hardened concrete
- CO2: Study in construction material are intended to make structural, Transportation and Foundation Engineers aware of the fundamental properties of materials they use.
- CO3: Construction Equipment introduction and its uses in civil engineering projects at site.
- CO4: To check the fundamental properties and engineering behavior of materials to performing the different test which are performed in the laboratory of that subject?
- CO5: Describe the characteristics and basic parameter of materials according to construction requirements.

- CO6: Overview about the advance construction materials, which are required in construction industry.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2/PSO1,PSO2
CO2	PO1, PO2/PSO1,PSO2,PSO3, PSO4
CO3	PO5, PO6/PSO3,PSO4
CO4	PO1, PO4, PO5, PO6/ PSO1, PSO3,PSO4
CO5	PO4, PO5, PO6/ PSO1, PSO3,PSO4
CO6	PO6, PO7/ PSO1, , PSO2,PSO3

BCEE 0011: STRUCTURAL DYNAMICS

Objective: *The objective of this course is to develop fundamentals about various dynamic problems of complex nature and response of structures to these conditions.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Types of dynamic loads, Basic background of methods available and motivation for structural dynamics **Dynamics of Single Degree-of-Freedom Structures**: Dynamic equation of equilibrium, Free vibration of single degree of freedom systems, Forced vibration: harmonic and periodic loadings, Dynamic response functions, force transmission and vibration isolation, SDOF response to arbitrary functions **Numerical Evaluation of Dynamic Response of SDOF Systems:** Time domain analysis: finite difference methods, Frequency domain analysis: basic methodology **Earthquake Response of SDOF Systems**: Earthquake excitation, response history and construction of response spectra, Response spectrum characteristics, tripartite plot, and design spectrum. **Multi Degree of Freedom Systems - Basics:** Dynamic equations of equilibrium, static condensation, Symmetric plan and plan-asymmetric systems.	20
II	**Free Vibration Response of MDOF Systems:** Un damped systems: natural modes and their properties, Numerical solution for the eigen value problem, Solution of free vibration response for un damped systems, Free vibration analysis of systems with damping. **Dynamic Analysis of Linear MDOF Systems**: Introduction, modal analysis, Response-history for earthquake excitations using modal analysis, Response spectrum analysis for peak responses, Concept of Caughey damping as a general type of proportional damping. **Generalized Single Degree of Freedom Systems**: Basic concepts, mass-spring system, Lumped mass systems, Systems with distributed mass and elasticity, Rayleigh's method, shape function selection.	20

Text Books:

- J. M. Biggs, Introduction to Structural Dynamics;2010.
- J. Krishna and A. R. Chandra Sekharan, Elements of Earthquake Engineering;1976.
- S. Prakash, Soil Dynamics, McGraw Hill;1981.

Reference Books:

- R.W. Clough & J. Penzien, Dynamics of Structures;2003.
- P. Agarwal & M. Srikhande "Earthquake Resistant Design of Structure";2006.
- Mario Piaz, Structural Dynamics;2013.
- A.K. Chopra, Dynamics of Structure;2011.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome:

After completing this course the students will be able to

- CO1: Recall the fundamental knowledge of dynamics and its application in the field of structures.
- CO2: Establishing dynamic equilibrium, the equation of motion
- CO3: Develop the background required for design of structures subjected to various forms of dynamic loadings including Earthquake and Blast.

- CO4: Implement of the establishment of dynamic equilibrium, the equation of motion
- CO5: Examine the eigen value problem and knowledge to its properties.
- CO6: Demonstrate degrees of freedom for single and multi degree of freedom systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

BCEC 0009: ADVANCED CONSTRUCTION ENGINEERING

Objective: *To enable the student learn theoretical and practical aspects of advancements in the field of construction engineering.*

Credits: 04 **L-T-P-J: 4-1-0-0**

Module No.	Content	Teaching Hours
I	Special concrete such as high strength, Lightweight, heavy weight, vacuum processed concrete, Mass concrete, high performance concrete, Pump-able concrete, Self-Compacting concrete, Air entrained concrete, Ferro cement, fiber reinforced concrete, Polymer impregnated concrete. Jet concrete. Recycling & re-use of industrial waste material. Deterioration and repair technology of concrete. Non-destructive testing of concrete quality, NDT evaluations (for strength, durability etc.) like Rebound Hammer, UPV, impact echo etc.; Technology used in various advanced instruments like Imaging techniques, GPR, Thermography, Tomography etc.	26
II	Pile Foundations : Introduction, uses, selection of pile, types of piles, pile spacing, group of piles, efficiency of group of piles, pile cap and pile shoe, load tests on piles, pile driving, pulling of piles, loads on piles, causes of failures of piles, pile driving formulas. Coffer Dams: Definition, uses, selection of cofferdams, types of cofferdams, design; Lesson Planning features of cofferdams; leakage prevention, economic height. Caissons: Definition, uses, construction material, types of caissons, loads on caisson, design features of caissons, floating of caissons, cutting edges, sinking of caisson, tilting of caisson, caisson diseases	14

Reference Books:

- S.P. Arora & S.P. Bindra, A Text Book of Building Construction, Dhanpat Rai &
- Sons, New Delhi.
- S.K. Sarkar and S. Saraswati, Construction Technology, Oxford University Press,
- New Delhi.
- B.C. Punamia, Building Construction, Laxmi Publications, New Delhi
- S.C. Rangwala, Building Construction, Charotar Publication Pvt Ltd. Anand

Focus: This course focuses on employability & Skill development aligned with CO2 and CO4

Outcomes: After completion of course, the student will be able to:

- CO1: Learn field applications in advanced construction technology.
- CO2: Learn advanced technology practices applied to real life problems.
- CO3: Understand the theoretical and practical aspects of new technology in civil engineering
- CO4: Understand the with the design and management applications

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2

BCEE 0010: EARTHQUAKE RESISTANT DESIGN

Objective: *The aim of this course is to impart the knowledge of basics of earthquake and its causes. This coursealsoincludesthestructuralmodelinganddynamicswithdesignofstructuresandearthquakeresistantdesignfeatures.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Engineering Seismology:** Earthquake ground motion- causes and classifications, Theory of plate tectonics, Seismic waves, Magnitude and intensity of earthquakes, local site effects, Seismic zoning map of India and geological considerations for construction of building project in seismic area . **Seismic Design Parameters:** Types of earthquakes, Earthquake ground motion characteristics, Response spectra and design spectrum. **Structural Modelling:** Response of structure to earthquake motion, Modelling of structures, Dynamics of single degree of freedom system,	15
II	Dynamics of multi degree of freedom system, Idealization of structures, **Earthquake Resistant Design:** Code based seismic design methods, Equivalent lateral force method, Response spectrum method, Time history method. **Design Features:** Reinforced concrete buildings, Material Properties, Codal provisions, Base Isolation, Seismic evaluation and retrofitting methods.	15

Text Books:

- Agarwal, P. and Shrikhande, M., Earthquake Resistant of Design of Structures, PHI Publications; 2007.
- Biggs, J.M., Introduction to Structural Dynamics, McGraw Hill Publications, NewYork, USA; 2004.
- Duggal, S.K.,Earthquake Resistant of Design of Structures, Oxford University Press, New Delh; 2008.
- IS:1983,Criterion for Earthquake Resistant Design, Bureau of Indian Standards, NewDelhi; 1984.

Reference Books:

- Chopra, A.K., Dynamics of Structures, Pearson Education, New Delhi; 2004.
- Paz, M., Structural Dynamics – Theory and Computation, Springer, New York, USA; 1997.

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand and apply the basics of structural dynamics in analysis of structures subjected to earthquakes.
- CO2: Explain basic terminology in seismology, seismicity and will be able to perform simple calculations on recorded earthquake ground motions.
- CO3: Discuss the ground motion magnitude, intensity, and frequency.
- CO4: Estimate responses of Single and Multi Degree of Freedom System
- CO5: Apply the basic codal provisions for earthquake resistant design of structures as per Indian standards.
- CO6: Understand the concepts of Base Isolation, Seismic evaluation and retrofitting methods..

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

BCEE 0801: CONSTRUCTION ENGINEERING LABORATORY

Objective: *The objective of this laboratory is gain practical idea about the behavior of construction materials especially cement, aggregates, bricks and concrete.*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Contents	Teaching Hours
I	A) Three experiments on each building material 1. Cement Tests (2 turns) Normal consistency of cement. Initial & final setting time of cement Compressive strength of cement Fineness of cement by air permeability and LeChatalier's Test 2. Coarse Aggregate Tests (2 turns) 3. Fine Aggregate Tests (2 turns) 4. Bricks Tests (2 turns) Water absorption. Dimension tolerances Compressive strength Efflorescence B) Test on Concrete: (4 turns) Workability test of concrete- Slump test. Design of concrete mix (as per IS method). Cube test of concrete (nominal mix).	20

Reference Books

- .M.L. Gambhir Concrete Technology, McGraw Hill Education, 2006.
- .B.L. Gupta Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
- A.M. Neville, Properties of Concrete, Prentice Hall, 1995, London.
- A.R. Santhakumar"Concrete Technology", Oxford University Press, 2007.
- M.S. Shetty, Concrete Technology, S.Chand and Company Ltd. Delhi, 2003

Focus: This course focuses on Skill development aligned with CO3 and CO4

Course Outcomes:

- CO1: Outline the importance of testing of cement and its properties
- CO2: Describe tests on coarse and fine aggregates
- CO3: Understand various parameters of brick testing
- CO4: Summarize the concept of workability and testing of concrete

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO5/PSO2
CO2	PO3/PSO2
CO3	PO4/PSO2
CO4	PO5/PSO2

BCEE 0803: ADVANCED CONSTRUCTION ENGINEERING LABORATORY

Objective: *To develop the understanding of modernized testing practices of construction facilities*

Credits: 01 **L-T-P-J: 2-1-0-0**

Module No.	Contents	Teaching Hours
I	1. Rebound hammer test-RH test 2. Ultrasonic pulse velocity- UPV test 3. Combined UPV & RH test 4. Core extraction for compressive strength test 5. Ingredient analysis of concrete core 6. Surface hardness test 7. Penetration and pullout techniques 8. Magnetic and electrical methods 9. Water permeability test 10. Chloride permeability test 11. Air permeability tests	20

Text Book:

- M. L. Gambhir and Neha Jamwal.," Building and Construction Materials: Testing and Quality Control "McGraw Hill, 2017

Focus: This course focuses on Skill development aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understanding of modern Testing methods in of construction materials in engineering.
- CO2: Understanding of use of modern Testing equipment's in field of construction.
- CO3: Application of modern Testing methods in of construction materials in engineering.
- CO3: Interpretation of the test data obtained from modern non-destructive testing methods
- CO5: Analyze the quality of construction with the help scientific and Non-destructive testing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2
CO5	PO1,PO2 PO3, PO4/PSO1, PSO2

BCEE 0101: FOUNDATION ENGINEERING

Objective: *The course provides a comprehensive learning of different type foundations and enable student to apply the knowledge gained of soil mechanics in analysis and design of foundation.*

Credits:03 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Stresses Due to Superimposed Loading:** Stresses in Soils, Boussinesq's and Westergaard's Theory for Determination of Stresses within Soils under Superimposed Loads and their Uses, Stresses due to Vertical and Horizontal Line Loads, Circular, Rectangular And Trapezoidal Loading, Stress Isobars and their Engineering Significance, Equivalent Point Load Method, Contact Pressure, Newmark's Influence Chart. **Soil Exploration:** Methods of Soil Exploration, Test Pits, Boring, Sampling, Penetration Tests (SPT, CPT and DCPT), Correlations between Penetration Resistance and Soil Design Parameters. **Earth Pressure:** Plastic Equilibrium of Soil, Rankine's Theory, Coulombs Wedge Theory, Earth Pressure on Retaining Walls.	15
II	**Stability Of Slopes** : Stability Analysis of Infinite and Finite Slopes, Planer and Circular Slip Surfaces, Culmann's Method, Taylor Stability Number and Stability Charts, Method Of Slices, Fellenius and Bishop's Method Of Stability Analysis. **Types of Foundations :**Shallow Foundation and Deep Foundation **Bearing Capacity:** Bearing Capacity of Shallow Foundation, Basic Definitions, Rankine's Analysis, Terzaghi's Analysis, Meyerhof's Analysis, Vesic's Bearing Capacity Equation, Effect of Water Table, Inclination and Eccentricity of the Applied Load on Bearing Capacity, Plate Load Test and Provisions of Indian Standard Code of Practice. **Pile Foundations**: Single and Group of Piles, Pile Capacity, Negative Skin Friction. **Settlement Analysis:** Immediate and Consolidation Settlement Analysis of Foundations, Time-Settlement Predictions, Construction Loading and Settlement Analysis, De Beer and Schmertman's Methods of Settlement Analysis.	15

Text Books:

- Arora K.R. "*Soil Mechanics & Foundation Engineering*" New Delhi: Standard Publishers Distributors; 2009.
- Bowles J.E. "Analysis and Design of Foundation" New York, USA: McGraw Hill Higher Education; 2001.
- Das B.M. " Principles of Foundation Engineering" New Delhi: Global Engineering Publishers; 2003.
- Murthy V.N.S"*Soil Mechanics and Foundation Engineering*" New Delhi: Marcel Dekker Publications; 2010.

Reference Books

- Peck, R.B. & Hanson, W.E., and Thornburn. "*Foundation Engineering*" New York,USA : John Wiley and Sons;1974.
- Ranjan, G. and Rao, A.S.R "*Basic and Applied Soil Mechanics*"New Delhi: New Age Publication; 2000.
- Venkataramaiah C. "*Geotechnical Engineering*" New Delhi: New Age Publications; 2006.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Course Outcomes: After completion of this course, student will be able to:

- CO1 Understand the behavior and response of soil under vertical stress imposed by applied load
- CO2 Familiarize with the investigation techniques used in subsurface exploration
- CO3 Assess the response of retaining walls under lateral earth pressure
- CO4 Learn the stability behavior of slopes
- CO5 Identify and analyze different types of foundation

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO12/ PSO3
CO2	PO1, PO2, PO4, PO5, PO12/ PSO3
CO3	PO1, PO2, PO4, PO12 / PSO3
CO4	PO1, PO2, PO3, PO4, PO12 / PSO3
CO5	PO1, PO2, PO4, PO12 / PSO3

BCEE 0102: GROUND IMPROVEMENT ENGINEERING

Objective: *The course provides a comprehensive learning of ground improvement techniques. This course will address the need of ground improvement and the techniques to achieve it.*

Credits:03 **L-T-P-J: 3-0-0-0**

Module No.	Contents	Teaching Hours
I	**Ground Improvement And Modification:** Introduction to Ground Improvement, New Technologies, Overview Of Various Techniques, Processes Of Modification and their Effect on Soils: Improvement by Excavation and Replacement, Mixing Additives : Chemicals, Lime, Cement, Ash, Slag, Bitumen, Electro Kinetic Process, Compaction Piles, Grouting: Principles, Techniques, Process, Control of Grout and Grouting Operation, Application **Reinforced Earth:** Reinforced Earth Principles and Advantages, Design Methods, Material Specification, Geo-synthetics: Geo-textiles, Geo-grids, Geo-nets, Geo-membranes, Geo-composite, Deep Compaction of Granular Soils, Vibro floatation, Vibro compaction, Blasting and Dynamic Compaction.	20
II	**Stabilization Of Soil:** Stabilization of Soil with Lime and Stone Columns, Principles, Laboratory and Field Investigations, Control, Design and Construction, Applications, Ground Anchors and Soil Nail Principles, Technology, Construction Process, Structural Elements, Pull-Out Capacity Estimates, Application Criteria, Design of Anchored Walls and Nailed Soil-Retaining Structures. **Sand Drains And Their Design:** Principles, Installation, Design and Application of Sand Drains. **Preloading: Principles**: Installation, Design and Application of Preloading With or Without Sand Drains.	20

Text Books:

- Bell F.C. " *Engineering Treatment of Soils*" London: Chapman and Hall;1993
- Fang, H.Y. "*Foundation Engineering Hand Book*" New Delhi:CBS Publishers;2004.
- Hausmann M.R. "*Engineering Principles of Ground Modification*" New Delhi: McGraw Hill; 1990.
- K. Rao N.S.V "*Vibration Analysis and Foundation Dynamics*" New Delhi:S. Chand Publications;2006.

Reference Books:

- Koerner R.M. *"Designing with geosynthetics*" London: Prentice Hall;1997.
- Swami Saran, "*Reinforced Soil and Its Engineering Applications*" New Delhi: I. K. International Publishers; 2010.
- Srbulov, M. "*Ground Vibration Engineering*" New USA: Springer Publishers,2010.

Focus: This course focuses on employability aligned with CO3 and CO5

Course Outcomes:

After completion of this course, student will be able to:

- CO1 Identify the need of ground improvement
- CO2 Learn different chemical and mechanical techniques to improve ground
- CO3 Understand the concept of reinforced earth
- CO4 Understand the basics of soil stabilizations
- CO5 Asses the functionality of sand drains

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO12/ PSO3

CO2	PO1, PO2, PO3,PO4, PO5, PO12/ PSO3
CO3	PO1, PO2, PO3, PO4, PO12 / PSO3
CO4	PO1, PO2, PO4, PO12 / PSO3
CO5	PO1, PO2, PO3, PO4, PO5, PO12 / PSO3

BCEE 0103: EARTH AND EARTH RETAINING STRUCTURE

Objective: *The course provides a comprehensive learning of the need of earth retaining structures. It will equipped the student with the knowledge of different earth retaining structures and enables them to perform analysis*

Credits:04 **L-T-P-J: 3-1-0-0**

Module No.	Contents	Teaching Hours
I	**Earth And Rock Fill Dams:** Earth and Rock Fill Dams, Types, Material, Foundation, Safety Requirements of Earth Dams, Seepage Analysis, Mechanically Stabilized Earth Retaining Walls, General Considerations, Backfill and Reinforced Materials, Construction Details, Design Method, Stability. **Soil Nailing:** Soil Nailing, Applications, Advantages, Limitations, Methods of Soil Nailing, Case Histories, Analysis and Design.	21
II	**Reinforced Soil:** Introduction, Basic Components, Strength Characteristics, Soil-Reinforcement Interface Friction, Reinforced Earth Wall, Stability Analysis, Construction Procedure, Drainage, Design Procedure, Foundation on Reinforced Soil Bed, Pressure Ratio, Analysis of Strip, Isolated, Square and Rectangular Footing on Reinforced Soil Bed, Ultimate Bearing Capacity of Footing on Reinforced Earth Slab, Fiber Reinforced Soil.	19

Text Books:

- Bell F.C. “Engineering Treatment of Soils” London: Chapman and Hall;1993.
- Bowles J.E. “Analysis and Design of Foundation” New York, USA:McGraw Hill Higher Education; 2001.
- Hausmann M.R. “Engineering Principles of Ground Modification” New Delhi: McGraw Hill; 1990.

Reference Books:

- Koerner R.M. “Designing with geosynthetics” US: Prentice Hall; 1997.
- Murthy V.N.S. “Soil Mechanics and Foundation Engineering” New Delhi: Marcel Dekker Publisher; 2010.
- S. Saran” Reinforced soil and its Applications” New Delhi: Gyan Books Pvt. Ltd.; 2011.

Focus: This course focuses on employability aligned with CO5 and CO4

Course Outcomes:

After completion of this course, student is able to:

- CO1 Identify the need of retaining the earth
- CO2 Assess the functioning of retaining structures made of earth
- CO3 Understand the basics of Earth dams
- CO4 Recognize the concept of soil nailing and learn its suitability
- CO5 Learn the basics of reinforced earth and discuss the concept of MSE

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO12/ PSO3
CO2	PO1, PO2,PO4, PO12/ PSO3
CO3	PO1, PO2, PO4, PO12 / PSO3
CO4	PO1, PO2, PO3, PO4, PO12 / PSO3

CO5	PO1, PO2, PO3, PO4, PO12 / PSO3

BCEE 0104: GEOTECHNICAL EXPLORATION & MEASURING TECHNINQUE

Objective: *To study the field soil exploration method for geotechnical investigations*

Credits:04 **L-T-P-J: 3-1-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Necessity and Importance of Soil Exploration, Method of Sub Surface Exploration Test Pits, Trenches, Caissons, Tunnels and Drifts, Wash Boring, Percussion Drilling , Rotary drilling, Factors Affecting the Selection of a Suitable Method of Boring. Extent of Boring, Factors Controlling Spacing and Depth of Bore Holes, Spacing and Depth of Various Civil Engineering Structures. **Indirect Method of Exploration-** Seismic method, Electrical resistivity, Resistivity Sounding and Profiling, Qualitative and Quantitative Interpretation of Test Results, Comparison of Resistivity and Seismic surveys, Shortcomings. Different Method of Stabilization of the Bore Holes, their Relative Merits and Demerits. **Ground Water Observation:** Different Method of Ground Water Observation: Time Lag in Observation, Sampling of Ground Water.	19
II	**Sampling**: Source of Disturbance and their Influence. Type of Sampler, Principle of Design of Sampler, Representative and Undisturbed Sampling in Various Types of Soils. Surface Sampling, Amount of Sampling, Boring and Sampling Record, Preservation and Shipment of Sample Preparation of Bore Log. **Penetration tests**: Standard Penetration Tests, Dynamic Cone Penetration Tests with and without Bentonite Slurry, Static Cone Penetration Tests, and Factor Affecting the Penetration Tests. Various Corrections in the Test Results. Interpretation of Test Result for Design and Determination of Modulus of Deformation. Small Size Penetrometers. Correlation among Various Test Results.	21

Text Books:

- Kurien N.P. "Design *of Foundation Systems: Principles & Practices*" New Delhi: Narosa; 1992.
- Bowles J.E. "*Analysis and Design of Foundation*" New York, USA: McGraw Hill Higher Education; 2001.
- Murthy V.N.S "*Soil Mechanics and Foundation Engineering*" New Delhi: Marcel Dekker Publishers; 2010.
- Ranjan G. and Rao A S R "*Basic and Applied Soil Mechanics*" New Delhi: New Age international Publishers; 2016.

Reference Books:

- Murthy V.N.S "Soil Mechanics and Foundation Engineering" New Delhi: Marcel Dekker Publishers; 2010.
- Ranjan G. and Rao A S R "Basic and Applied Soil Mechanics" New Delhi: New Age international Publishers; 2016.

Focus: This course focuses on employability aligned with CO3 and CO1

Outcomes:

After completion of this course, student will able to:

- C01:Understand types of sub soil exploration for Determining the nature of soil at the site and its stratification
- C02:Necessity and types of indirect approach for subsoil exploration for larger area. Techniques for borehole stability technology to maintain a stable borehole, both during and after drilling
- C03: Understand determination of the elevation of the ground surface at each monitoring location.
- C04:DevelopeInformation on the physical properties of soil and rock around a site to design foundation for proposed structures. Also give a clear idea about sampling methods.
- C05: Understand Idea regarding different types of penetration test on field and correlation regarding accessing properties.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO5 /PSO3
CO2	PO1,PO2,P05/PSO3
CO3	PO1,PO5 /PSO3
CO4	PO1,PO2,PO5 /PSO3
CO5	PO1,PO5 /PSO3

BCEE 0105: ADVANCED FOUNDATION DESIGN

Objective: *To study the shallow and deep foundation, and analyses soil stability design for geotechnical application.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Contents	Teaching Hours
I	**Stress Distribution In Soils:** Elastic Solutions: Point Load, Line Load, Strip Load: Uniform, Triangular and Trapezoidal Variation of Load, Uniform Load on Circular, Rectangular, Irregular Areas. Approximate Methods, Applications to Real Problems. **Bearing Capacity And Settlement Analysis Of Shallow Foundations:** Types of Bearing Capacity Failures, Meyerhoff and Hansen's Bearing Capacity Equations, BIS Bearing Capacity Equation, Immediate and Consolidation Settlements in Cohesive Soil, Skempton-Bjerreum Settlement Correction, De-Beer and Schmmertman's Methods of Settlement Prediction in Non-Cohesive Soil. **Piles And Pile Groups:** Classification of Piles, Construction and Installation of Piles, Load Carrying Capacity of Single Piles in Clay, Silt and Sand by Dynamic and Static Methods, Pile Load Test, Pile Group, Negative Skin Friction, Settlement of Pile Group, Foundation on Expansive Soil, Construction on Expansive Soil, Alteration of Soil Condition, Under-Reamed Piles.	20
II	**Well Foundation:** Elements of Well Foundation, Shape, Depth Of Scour, Well Sinking, Tilt, Shift and Their Prevention. Design Principles. **Stability Of Slopes:** Limit Equilibrium Method, Method of Slices, Rigorous and Simplified Bishop Method,Spencer's Method, Stability Charts, Janbu's Generalized Procedure of Slices. **Machine Foundation:** Classification, Definitions, Types of Machine Foundations, Free and Forced Vibrations, Design Principle, Barkan's Method.	20

Text Books:

- Arora K.R. "*Soil Mechanics and Foundation Engineering*" New Delhi: Standard Publishers; 2009.
- Bowles J.E. "*Analysis and Design of Foundation*"New York: McGraw Hill Higher Education's; 2001.
- Das B.M "*Principles of Foundation Engineering*" New Delhi: Global Engineering Publishers; 2003.
- Murthy V.N.S. "*Soil Mechanics and Foundation Engineering*" New Delhi: Marcel Dekker Publishers; 2010.
- Poulos H.G. & Davis E. H. "*Pile Foundation Analysis and Design* "John Wiley & Sons; 1980.
- Tonilinson M.J. "*Design and construction*" Longman Higher Education; 1996.
- C. Venkataramaiah "*Geotechnical Engineering*" New Delhi: New Age Publishers; 2006.

Reference Books:

- H.G. Poulos & E. H. Davis "Pile Foundation Analysis and Design "John Wiley & Sons; 1980.
- M.J. Tonilinson "Design and construction" Longman Higher Education; 1996.
- C. Venkataramaiah "Geotechnical Engineering" New Delhi: New Age Publishers; 2006.

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome:

After completion of this course, student will be able to:

- C01: Develope concept of Stress distribution methods to estimate the stress distribution of soil for an applied load.

- C02: Design approach to access allowable bearing capacity and settlement for cohesive and cohesionless soil.
- C03: Analysis and design approach of pile foundation and construction approach.
- C04: Design and construction approach of well foundation, Idea of scouring that required for bridge design and in other constructions purposes.
- C05: Assessment of the stability of slopes under both short-term and long-term scenarios using different types of mechanism which essential for simulation in limit equilibrium approach and finite element analysis.
- C06: Understand design criteria of Machine foundation for Design considering static load and kinetic forces.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
CO1	PO1,PO3 /PSO3
CO2	PO1,PO2,PO3,PO5 /PSO3
CO3	PO1,PO2,PO3 /PSO3
CO4	PO1,PO2,PO3 /PSO3
CO5	PO1,PO2 /PSO3
CO6	PO1,PO2,PO3 /PSO3

BCEE 0106: ADVANCED FOUNDATION ENGINEERING

Objective: *To study the shallow and deep foundation, and analyses soil stability and designing retaining wall for geotechnical application.*

Credits:03 **L-T-P-J: 3-0-0-0**

Module No.	Contents	Teaching Hours
I	**Selection of foundation and Sub-soil exploration/investigation:** Types of foundation, Factors affecting the selection of type of foundations, steps in choosing types of foundation based on soil condition, Objectives and planning of exploration program, methods of exploration-wash boring and rotary drilling-depth of boring, soil samples and soil samplers-representative and undisturbed sampling, field penetration tests: SPT, SCPT, DCPT. Introduction to geophysical methods, Bore log and report writing, data interpretation. **Shallow Foundation:** Introduction, significant depth, design criteria, modes of shear failures Detail study of bearing capacity theories (Prandtl, Rankine, Terzaghi, Skempton), bearing capacity determination using IS Code, Presumptive bearing capacity. Settlement, components of settlement & its estimation, permissible settlement, Proportioning of footing for equal settlement, allowable bearing pressure. Bearing capacity from in-situ tests (SPT, SCPT, PLATE LOAD), Factors affecting bearing capacity including Water Table., Bearing capacity of raft/mat foundation as per I.S. code provisions, Contact pressure under rigid and flexible footings. Floating foundation. Types of pavements & its design. **Pile foundations:** Introduction, load transfer mechanism, types of piles and their function, factors influencing selection of pile, their method of installation and their load carrying characteristics for cohesive and granular soils, piles subjected to vertical loads- pile load carrying capacity from static formula, dynamic formulae (ENR and Hiley), penetration test data & Pile load test (IS 2911). **Pile group:** Carrying capacity, efficiency and settlement. Negative skin friction	20
II	**Foundations on problematic soil & Introduction to Geosynthetics:** Significant characteristics of expansive soil, footing on such soils, Problems and preventive measures. Under-reamed pile foundation-its concept, design& field installation. Significant characteristics of silt and loess, problems & remedial measures footing on such soils, introduction to geosynthetics-types and uses. **Retaining walls:** Types (types of flexible and rigid earth retention systems: counter fort, gravity, diaphragm walls, sheet pile walls, soldier piles and lagging).	10

Text Books:

- P. Purushothama Raj *Soil Mechanics and Foundation Engineering* Chennai: Pearson Education; 2007.
- B.C. Punmia *Soil Mechanics & Foundation Engineering* New Delhi: Laxmi Pub. Pvt. Ltd.; 2017.
- Alam Singh *Soil Mechanics & Foundation Engineering* New Delhi: CBS Publishers & Distributors; 2009.
- D.W. Taylor *Fundamentals of Soil Mechanics* Mumbai: Asia Publishing House; 1955

Reference Books:

- V. N. S. Murthy Soil Mechanics & Foundation Engineering Sai Kripa Bangalore: Technical Consultants; 2018.
- Gopal Ranjan, A.S.R. Rao Basic and applied soil mechanics New Delhi: New Age int. (P) Ltd; 2016.
- K.R. Arora Soil Mechanics and Foundation Engineering New Delhi: Standard Pub.; 2009.
- M Das Braja Principles of Geotechnical Engineering New Delhi: Cengage Learning; 2001.

IS Codes:

- Code of practice for determination of bearing capacity of shallow foundation IS:6403
- Code of practice for design and construction of pile foundation- IS:2911 (Part I to IV)
- Method for standard penetration test for soil- IS:2131
- Code of practice for subsurface investigation for foundation- IS:1892
- Code of practice for structural safety of buildings: Shallow Foundations- IS:1904
- Code of practice for calculation of settlement of foundations- IS:8009

Focus: This course focuses on employability & Skill development aligned with CO3 and CO6

Outcome:

Upon successful completion of this course, the student will be able to:

- C01: Understand appropriate soil investigation/testing technique/method and get true sub soil parameters used for selection of type of foundation as per Indian Standard guidelines.
- C02: Understand Bore log details, Select and design appropriate/suitable foundation system (shallow/Deep) for different structures, that satisfy the allowable bearing capacity. Calculation of bearing capacity and Settlement calculation for different footing condition
- C03: Analyzed Design deep foundation satisfying bearing capacity and settlement requirements.
- C04: Understand study the effect of pile group in practical field.
- C05:Understand the engineering behavior of expansive soils and selection of suitable foundation type for such soils. Selection of alternate materials, like geosynthetics and its application, in foundation problems.
- C06:Design and analysis of retaining walls and sheet piles under static loads.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3 /PSO3
CO2	PO1,PO2,PO5 /PSO3
CO3	PO1,PO2,PO5,PO5 /PSO3
CO4	PO1,PO2,PO3 /PSO3
CO5	PO1,PO2 /PSO3
CO6	PO1,PO2,PO3 /PSO3

BCEE 0108: GEOSYNTHETIC& REINFORCED SOIL STRUCTURES

Objective: *To study Reinforced soil wall design as per Morth Specification and IRC: SP guideline.*

Credits:03 **L-T-P-J: 3-0-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Ground Improvement**: Introduction to Ground Improvement Techniques, Processes of Soil Modification and their Effect on Soils. **Introduction to Geosynthetics:** Introduction and need of geosynthetics, Historical background, early applications, basic principle of reinforced soil, Types of geosynthetics and their applications**,** Manufacturing of geosynthetics. Strength of reinforced soils, Testing of Geosynthetics **Earth Retaining Structures:** Different Types of Soil Retaining Structures, Construction Aspects of Geosynthetic Reinforced Soil Retaining Walls, Design Codes for Reinforced Soil Retaining Walls **Stability Analysis:** External Stability Analysis of Reinforced Soil Retaining Walls, Seismic Loads and Internal Stability Analysis of Reinforced Soil Walls, Testing Requirements for Reinforced Soil Retaining Walls. infinite and finite slopes, Stability analysis of reinforced soil slopes resting on soft foundation soils, Stability analysis of reinforced soil slopes resting on strong foundation soil. bilinear wedge analysis, Design of Embankments supported on Load Transfer Platforms, Reinforced soil for supporting shallow foundations	15
II	**Design of Reinforced Soil Retaining Walls**: simple geometry , sloped backfill soil , Design of reinforced soil retaining walls supporting a bridge abutment **Application of Geosynthetics:** Accelerated consolidation of soft clays using geosynthetics , Geosynthetic encased stone columns for load support , Drainage application of geosynthetics , Filtration Applications of Geosynthetics , Erosion control using geosynthetics , Natural geosynthetics and their applications , Geosynthetics for construction of municipal and hazardous waste landfills	15

Text Books:

- F.C. Bell “ *Engineering Treatment of Soils*” London: Chapman and Hall;1993
- H.Y Fang,. “*Foundation Engineering Hand Book*” New Delhi: CBS Publishers; 2004.

Reference Books:

- M.R Hausmann. “Engineering Principles of Ground Modification” New Delhi: McGraw Hill; 1990.
- N.S.V Kameswara Rao “Vibration Analysis and Foundation Dynamics” New Delhi: S. Chand Publications; 2006.

Focus: This course focuses on employability & Skill development aligned with CO6 and CO4

Outcome:

Upon successful completion of this course, the student will be able to:

- C01: Develop basic idea about ground improvement Engineering and its requirement
- C02: Develop idea about geosynthethic material, its working principle, characteristics
- C03: Design approach of geosyntheic reinforced soil structure and related codes
- C04: Design approach of external and internal stability of reinforced soil structure
- C05: Analyze the stability of earth retaining structures and earth slopes.

- C06: Understand the wide area of application of geosynthetics

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3 /PSO3
CO2	PO1,PO2,PO5 /PSO3
CO3	PO1,PO2,PO5,PO12 /PSO3
CO4	PO1,PO2,PO3 /PSO3
CO5	PO1,PO2 /PSO3
CO6	PO1,PO2,PO3 /PSO3

BCEE 0804: GEOSYNTHETIC TESTING LABORATORY

Objective: *To study the geosynthetic testing and to assess the performance of geosynthetics*

Credits:02 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I/II	• Physical Properties: Mass per unit area, thickness, specific gravity of geosynthetic • Mechanical Properties: Drop cone test; Puncture resistance, Grab strength contd. and triaxial test, Direct Shear and Pull-out test, Tensile strength and trapezoidal tear strength • Hydraulic Properties Permittivity and transmittivity Endurance Properties Abrasion test; Ultraviolet degradation and Gradient Ratio, • Tests on Geofoam: Density of geofoam, Water absorption test, Compressive Properties; Tensile properties	26

Text Books:

- D.G.Devshikar, J.N.Mandal "*A Guide to Geotextiles Testing Paperback*" New Age International Private Limited, 2002.
- Robert M. Koerner "*Designing with Geosynthetics*" - 6Th Edition Vol. 1", Xlibris US

Reference Books:

- ASTM D4354 "*Standard Practice for sampling of Geosynthetics for Testing"*
- IS standard code for geosynthetic properties
- ISO standard for Geosynthetic sampling and preparation of test sample

Focus: This course focuses on Skill development aligned with CO1 and CO4

Outcome:

After completion of this course, student will able to:

- C01: Understand types of properties of geosynthetic
- C02: Understand mechanical properties of geosynthetic
- C03: Understand hydraulic properties of geosynthetic
- C04: Determination of properties of Geofoam

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO5 /PSO3
CO2	PO1,PO2,PO5/PSO3
CO3	PO1,PO5 /PSO3
CO4	PO1,PO2,PO5 /PSO3

BCEE 0214: ENGINEERING HYDROLOGY

Objective: *To build on the student's background in hydrology and hydraulics and understanding of water resources systems and to develop the skills in modeling of flood flows and flood routing and also to develop skills in the ground water flow, type of aquifer and yield from the well.*

Credits: 03 **L-T-P-J: 2-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: History of Hydrology, Hydrological Cycle, World Water Quantities, Applications of Hydrology in Engineering. **Precipitation:** Forms of precipitation, Measurement of precipitation, Average Depth of rainfall over area, Mean Annual Rainfall, Rain gauge Network, Consistency of Rainfall data.	15
II	**Hydrological Abstractions**: Evaporation, Transpiration and Evapotranspiration, Runoff , Factors affecting runoff, Infiltration process, Infiltration capacity curve. **Stream Flow**: Factors affecting stream flow, Measurement of stream flow, Hydrograph analysis, Preparation of unit hydrograph, Synthetic hydrograph, Instantaneous unit hydrograph.	15

Text Books:

- G.L. Asawa, "*Irrigation and Water Resources Engineering*", New Delhi New Age International (P) Limited, Publishers. (2005)
- C.S.P. Ojha, R. Berndtsson, and P. Bhunya, "*Engineering Hydrology*", New Delhi Oxford University Press, (2008)

Reference Books:

- V.P. Singh, "*Elementary Hydrology*", New Delhi Prentice-Hall. (1992)
- K. Subramanya, "*Engineering Hydrology*", New Delhi Tata McGraw-Hill Publishing Company Limited. (1994),
- D.K. Todd, and L.W. Mays, "*Groundwater Hydrology, 3rd Edition*", U.S.A. John Wiley & Sons, Inc., (2004)

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: *Analyze hydro-meteorological data*
- CO2: *Estimate abstractions from precipitation*
- CO3: *Compute yield from surface and subsurface basin*
- CO4: *Develop rainfall-runoff models*
- CO5: *Formulate and solve hydrologic flood routing models*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1

CO5	PO1,PO2 /PSO1

BCEE 0202: GROUND WATER MANAGEMENT

Objective: *To comprehend differential equations governing ground water flow in polar coordinates and to develop basic know about the management of ground water.*

Credits: 03 **L-T-P-J: 2-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Ground Water Occurrence and Its Role in Hydrologic Cycle, Vertical Distribution of Ground Water, Ground Water Bearing Formations, Aquifer and Its Classification, Flow and Storage Characteristics of Different Types of Aquifers, Storage Release Mechanisms of Aquifers. **Equations for Flow Through Porous Media**: Darcy's Law and Differential Equations Governing Ground Water Flow in Cartesian Coordinates, Dupuit- Forchheimer Assumptions.	15
II	**Ground Water Management:** Ground Water Exploration Methods, Types of Wells, Construction of Wells, Well Completion and Development, Well Protection, Contamination of Ground Water. **Well Hydraulics**: Differential Equations Governing Ground Water Flow in Polar Coordinates, Well Hydraulics, Well Interference, Wells Near Boundaries, Test Pumping Analysis.	15

Text Books:

- D.K. Todd, "*Ground Water Hydrology*", New York John Wiley and Sons. (2001),
- A.I Kashef,."*Ground Water Engineering*", New York McGraw-Hill Book Company, (1987),

Reference Book:

- H.M. Raghunath, "*Ground Water*", New Delhi New Age International (P) Limited, Publishers, (1990),

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: *learn how ground water can store and in how many ways we can store water for further use.*
- CO2: *Understanding the role of hydrological cycle in recharge of ground water.*
- CO3: *To develop and design of well and monitor recharge capacity as well as efficiency of well.*
- *CO4: understand the occurrence of ground water, different types of aquifers and the flow of ground water using various equations.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1

BCEE 0203: HYDROPOWER ENGINEERING

Objective: *to design a hydroelectric plant utilizing optimal energy in the water, with minimum submergence and economic costs, considering seasonal variation in power generation to meet the region's demand during all seasons.*

Credits: 03 **L-T-P-J: 2-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Sources of Energy, Comparison of Hydropower With Other Sources of Power, Hydropower Potential in India, Basin-Wise Development of Hydropower in India, Constraints in Hydropower Development. **Types of Hydropower Plants**: Base and Peak Load Hydropower Plants, Run-of-River Plants, Valley Dam Plants, Diversion Canal Plants, High Head Diversion Plants, Pumped-Storage Power Plants, **Stream Flow Data For Hydropower Potential:** Flow and Load Duration Curves, Primary and Secondary Power, Storage and Pondage, Load Factor, Capacity Factor, Utilization Factor, Diversity Factor.	15
II	**Conveyance System**: Power Canal and Its Alignment; Surges in Power Canals, Types, Design, and Layout of Penstocks, Economical Diameter of Penstock. **Hydraulic Transients:** Functions, Types, Location, and Design of Surge Tanks. **Turbines:** Types, Characteristics, Efficiency, and Selection Criteria For Turbines, Cavitation, Casing, Draft Tubes, Tail Race.	15

Text Book:

- R.S. Varshney, "*Hydropower Engineering*", Roorkee Nem Chand and Brothers, (2001),

Reference Book:

- C.C. Warnick, "*Hydropower Engineering*", New Delhi Prentice Hall (1984),

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: *Identify types of hydropower plants*
- CO2: *Estimate hydropower potential*
- CO3: *Design of penstocks and surge tank*
- CO4: *Plan the layout of a hydropower plant*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 /PSO1
CO3	PO1, PO2, PO3 /PSO1
CO4	PO1, PO2 /PSO1

BCEE 0204: HYDRAULIC STRUCTURES

Objective: *This course is designed to study the fundamental concept, design and maintenance of hydraulic structures. Also to provide basic understanding of heavy structures like dam have to study. To give the basic idea of canal regulation, canal headwork and cross-drainage.*

Credits: 03 **L-T-P-J: 2-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Various Kinds of Hydraulic Structures for Water Resource Projects. **Embankment Dams:** Types and Advantages of Embankment Dams, Design and Safety Considerations, Factors Influencing Design of Embankment Dams, Analysis and Control of Seepage Through Embankment Dams, Stability Analysis of Embankment Dams. **Gravity Dams:** Forces and Load combination on a gravity dam, Stress analysis, Mode of failure of gravity dams , Elementary and practical profile of a gravity dam, method of design of gravity dams.	15
II	**Buttress and Arch Dams**: Buttress dam. Types and forces on buttress dam, Advantages and disadvantages of buttress dams, Arch dams, Types and forces on Arch Dams. **Spillways:** Types, Spillways Capacity, Components of spillways, Energy dissipaters.	15

Text Books:

- G.L. Asawa, "*Irrigation and Water Resources Engineering*", New Delhi New Age International (P) Limited, Publishers, (2005).
- B.C. Punmia, "*Irrigation and Water Power Engineering*", New Delhi Laxmi Publications, (1992)

Reference Books:

- R.S. Varshney, "*Hydropower Structures including Canal Structures and Small Hydro*", Roorkee Nem Chand and Brothers, (2001).

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4
Outcome: After completion of course, the student will be able to:

- CO1:*Analyze factors effecting selection of regulatory works such as canals ,spillways*
- CO2:*Understand about the types of fall in canals and its application which have designed in the all cases.*
- CO3:*Deals the causes of failure of the canals and spillways.*
- CO4:*design of canals, diversion; storage head works by the Bligh's and khosla's theory.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2,PO3 /PSO1

BCEE 0211: INTRODUCTORY RURAL WATER SUPPLY

Objective: *To understand the techniques and methods for rural drinking water Management*

Credits: 03 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Fundamentals of Rural Water Supply: Issues of rural water supply – Various techniques for rural water supply, National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies. Low Cost Water Treatment, Specific contaminant removal systems **Sources of Water**: Traditional Sources of Water in Rural Areas, Different Types of Wells, Sanitary Aspects in Well Construction, Water Harvesting Techniques.	15
II	**Water Treatment**: Disinfection of Rural Water Sources, Fluoride and Its Removal, Diatomaceous Earth Filter, Cloth Filter, Slow Sand Filter. **Rural Sanitation**: Biogas, Collection and Disposal of Wastes, Community Awareness and User Participation, Planning of Communication Support in Rural Supply and Sanitation Projects. **Solid Waste Management in rural areas**: Disposal of Solid Wastes- Composting-land filling, Incineration, Biogas plants, Other specific issues and problems encountered in rural sanitation.	15

Text Books:

- S.K. Garg Water Supply Engineering (Environmental Engineering Vol.-I) New Delhi: Khanna Publisher; 2008.
- S.K. Garg Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol.-II) New Delhi: Khanna Publishers; 2008.
- H.T. Mann and D. Williamson, Water Treatment and Sanitation – Simple Method for Rural Area London: UK Intermediate Technology Publications; 1982.
- B.C Punmia. Water Supply and Wastewater Engineering Vol. I and II New Delhi: Laxmi Publications; 2010.

Reference Books:

- D. Srinivasan Environmental Engineering New Delhi: PHI Learning Pvt. Ltd; 2009.
- E.W. Steel and T.J. McGhee Water Supply and Sewerage New York, USA; McGraw-Hill; 1991.
- E.G. Wanger and J.N. Lanoix Water Supply for Rural Areas and Small Communities Geneva: WHO; 1991.

Focus: This course focuses on employability aligned with CO5 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand water quality concepts and their effect on treatment process selection for rural areas
- CO2: Differentiate between options for centralized and urban systems versus decentralized and rural systems
- CO3: Understand the importance of water treatment for rural water supply systems
- CO4: Understand the available techniques and methods for rural drinking water treatment
- CO5: Learn about the different methods available for rural sanitation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

BCEE 0206: INTRODUCTION TO CLIMATE CHANGE STUDIES

Objective: *To understand the process of climate change and global warming*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Basics of Atmospheric circulation:** Movement of air masses; atmosphere and climate; air and sea interaction; El Nino and La Nina; tropical cyclone; Indian monsoon and its development, changing monsoon in Holocene in the Indian subcontinent, its impact on agriculture, effect of urbanization on micro climate; Asian brown clouds. **Energy Balance:** Earth's energy balance; energy transfers in atmosphere; Earth's radiation budget; green house gases (GHGs); greenhouse effect. **Meteorology and atmospheric stability:** Meteorological parameters (temperature, relative humidity, wind speed and direction, precipitation); atmospheric stability and mixing heights; temperature inversion; plume behavior; Gaussian plume model.	15
II	**Global warming and climate change:** Atmospheric structure and composition, atmospheric windows, Trends of global warming and climate change; drivers of global warming and Global Warming Potential (GWP) & climate change; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species, CO_2 fertilization and agriculture; impact on economy and spread of human diseases. **Ozone layer depletion:** Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion; **Environmental policy & agreements** Mitigation measures and international protocols. Environmental policy; International agreements; Montreal protocol 1987; Kyoto protocol 1997; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.	15

Text Books:

- Neelin JD *Climate Change and Climate Modeling* New Delhi: Cambridge University Press; 2010.
- JP Peixoto and AH Oort. *Physics of Climate* NY: American Institute of Physics; 1992.
- C.J. Jepma and M. Munasinghe *Climate Change Policy – Facts, Issues and Analysis* New Delhi: Cambridge University Press; 1998

Reference Book:

- Sushil Kumar Dash Climate Change – An Indian Perspective New Delhi: Cambridge University Press India Pvt. Ltd; 2007.

Focus: This course focuses on employability aligned with CO3 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic of Energy balance modeling
- CO2: Evaluate the various factors that shape climate

- CO3: Understand the basics of Climate Change Modeling
- CO4: Learn the basics of Climate change and its effect
- CO5: Understand the process of climate change and global warming
- CO6: Learn the techniques of climate change mitigation

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1
CO6	PO1,PO2 /PSO1

BCEE 0207: ENVIRONMENTAL INSTRUMENTATION AND ANALYSIS

Objective: *To learn about different Instruments used for the environmental analysis*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Spectrometry and Photometry:** UV-Vis Spectrophotometer, Flame Photometer, Infrared Spectrophotometer, Atomic Absorption Spectrophotometer (AAS), Mass Spectrometry (MS), Fourier transform infrared spectroscopy (FTIR), Nuclear Magnetic Resonance (NMR), Inductively coupled plasma spectrometry (ICPMS).	20
II	**Chromatography:** Basic theory and types of chromatography, Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC), Ion Chromatography (IC). **Ion Selective Electrodes:** Operating principle, Primary components, Applications in environmental analysis. Polarography and cyclic voltametry. Total Organic Carbon Analysis: Operating principle and primary components	20

Text Books:

- HH Willard, LL Merritt, and JA Dean Settle. Instrumental Methods of Analysis (6th ed.) - CBS Publishers, New Delhi, 1986.
- DA Skoog, DM West, T Holler Fundamentals of Analytical Chemistry (6th ed.) - Saunder's Publication, 1992.

Reference Books:

- RL Recsok, LD Shields, John Wiley & sons Modern Methods of Chemical Analysis - Inc, 1990.
- GW Ewing, McGraw Hill Book Company Instrumental Methods of Chemical Analysis – Inc. 1975
- CN Banwell, Fundamentals of Molecular Spectroscopy –McGraw Hill, NY, 1990.

Outcome: After completion of course, the student will be able to:

- CO1: learn the basics of Environmental Instruments and its Process
- CO2: Depict the information about various Chemical Analysis Technique
- CO3: Learn basics of Spectrometry and Photometry
- CO4: Understand the basic theory and types of chromatography
- CO5: Learn the need of Environmental Analysis of various pollutants

BCEE 0208: ADVANCED GEOINFORMATICS

Objective: *To understand the concept of GIS and Remote Sensing Process*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Photogrammetry:** Aerial Photographs- Basic terms & Definitions, scales, relief displacements, Flight Planning, Stereoscopy, Characteristics of photographic images, Fundamentals of aerial photo-interpretation. **Remote Sensing:** Fundamentals of remote sensing, Remote sensing satellites and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution. Airborne and satellite borne RADAR –SAR –LIDAR, High Resolution Sensors	15
II	**Satellite Image -** Characteristics and formats, Introduction to Image rectification & Image Enhancement, Unsupervised and Supervised Classification, basic characteristics of image elements – interpretation keys (selective and elimination) – visual interpretation of natural resources. Applications of remote sensing. **Geographical Information system:** Introduction to GIS - Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Types of data – Spatial, Attribute data- types of attributes – geospatial analysis. Applications of GIS **Global Positioning system**: Global Navigation Satellite System (GNSS) GPS, GPS Segment: Space segment, Control segment, User segment, GPS satellite signals, coordinate system and map projection, Static, Kinematic and Differential GPS, GPS Applications	15

Text Books:

- L. B. Campbell "Introduction to remote sensing" New Delhi: Taylor Publications; 2002.
- S. A. Drury "Image Interpretation in Geology" Australia: Allen and Unwin; 1987.
- R.P Gupta: "Remote Sensing Geology" New Delhi: Springer Verlag; 1990

Reference Books:

- M. Anji Reddy "*Textbook of Remote Sensing and Geographical Information system"* Hyderabad BS: Publications; 2011.
- M. Lillesand Thomas, W. Kiefer Ralph, and W. Chipman Jonathan "*Remote sensing and image interpretation"* New Delhi: John Wiley & Sons; 2008.
- Kang tsung Chang "*Introduction to Geographical Information System*" 7th ed. New Delhi: Tata McGraw Hill; 2010.
- A.M. Chandra and S.K. Ghosh. "*Remote Sensing and Geographical Information system"* New Delhi: Narosa Publishing House; 2006.

Focus: This course focuses on employability aligned with CO1 and CO2

Outcome: After completion of course, the student will be able to:

- CO1: Understand the representation Earth's surface characteristics
- CO2: Comprehend the effect local Attraction and practical errors
- CO3: Develop basic knowledge of GIS
- CO4: Understand fundamental aspects of Photogrammetry
- CO5:"Recognize and understand fundamental principles of remote sensing, including the electromagnetic spectrum."

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

BCEE 0209: APPLIED HYDROLOGY

Objective: *To build on the student's background in hydrology and hydraulics and understanding of water resources systems and to develop the skills in hydrological modeling and also to develop skills in the ground water flow, type of aquifer and yield from the well.*

Credits: 03 **L-T-P-J: 2-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Applications of various Remote Sensing techniques in Hydrology. Introduction of Various Software's used in Hydrology. **Precipitation:** Depth-Area-Duration Relationship, Intensity-Duration-Frequency Relationship, Probable Maximum Precipitation (PMP).	15
II	**Hydrological Abstractions**: Basic concepts and approaches, Measurement and estimation of evapotranspiration, Introduction of various software's for Hydrological Modelling **Hydrograph Analysis**: Preparation of unit hydrograph, Synthetic hydrograph, Instantaneous unit hydrograph. **Flood Modeling:** Design Flood & it's estimation, Reservoir flood routing; Hydrologic flood routing.	15

Text Books:

- P. S. Eagleson, " *Dynamic hydrology* "New York: McGraw Hill Book Co;1970
- L. J. Battan, " *Fundamentals of meteorology*" New Jersey: Prentice Hall Inc. Englewood Cliffs,;1984
- G. W Kite, "*Frequency and risk analysis in hydrology*" Colorado: Water resources publication, Fort Collins,;1977
- A. Lattermann, "*System-Theoretical modeling in surface water hydrology* " Verlag: Springer;1991

Reference Books:

- V.P. Singh, "*Elementary Hydrology*", New Delhi: Prentice-Hall;1992
- K Subramanya, "*Engineering Hydrology*", New Delhi: Tata McGraw-Hill Publishing Company Limited;1994
- D.K. Todd, and L.W. Mays, "*Groundwater Hydrology, 3rd Edition*", U.S.A: John Wiley & Sons, Inc;2004

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: *Analyze hydro-meteorological data*
- CO2: *Estimate abstractions from precipitation*
- CO3: *Compute yield from surface and subsurface basin*
- CO4: Analyze Hydrological Modeling Software's

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1

BCEE 0210: ADVANCED CLIMATE CHANGE AND MODELING

Objective: *To understand the process of Climate change and Modelling*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	Causes of climate change Global warming and climate change, Observed climate change and international responses, Effects of climate change -Policy and legislation, Greenhouse Gases. The global carbon cycle – biogeochemistry, Lapse Rate. **Energy balance models:** Energy balance models and glacial cycles, box models, general circulation modeling of the atmosphere. Global atmospheric circulation. Impacts of climate change on Freshwater Resources, Terrestrial and Inland Water Systems (Ecosystems), Ocean Systems, Human Health.	15
II	**Modeling of atmospheric chemistry,** working with climate models, climate model evaluation, climate model predictions and policy, volcanic eruptions; detection and attribution of anthropogenic forcing. **International Agreements**: the United Nations Framework Convention on Climate Change (UNFCC), Kyoto Protocol, Paris Agreement.	15

Text Books:
- JD Neelin. Climate Change and Climate Modeling New Delhi: Cambridge University Press; 2010.
- JP Peixoto and AH Oort Physics of Climate NY: American Institute of Physics; 1992.

Reference Books:
- DL Hartmann *Global Physical Climatology* San Diego: Academic Press; 1994.
- WM Washington and CL Parkinson *An Introduction to Three-Dimensional Climate Modeling* 2nd ed.UK: Univ. Science Books; 1998.

Focus: This course focuses on employability aligned with CO1 and CO4
Outcome: After completion of course, the student will be able to:
- CO1: learn the basics of Climate change and its effect
- CO2: Understand the process of Modeling of Climate change
- CO3: Demonstrate a solid understanding of the climate system
- CO4: Evaluate the various factors that shape climate
- CO5: Understand the basic of Energy balance modeling

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

BCEE 0212: ADVANCED WATER TREATMENT TECHNOLOGIES

Objective: *To Learn Advanced water and water treatment technologies*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Overview of Advanced Waste Water Treatment**: Nutrient Removal – Nitrogen & Phosphorus Nitrogen Removal: Nitrification, Denitrification. Phosphorus Removal: Introduction, Phosphorus removal by Chemical Precipitation: Principles of process, Chemicals applied, Chemistry of phosphorus precipitation, Process configuration, Phosphorus removal by Biological Precipitation: Principles of the process, Microorganisms involved in the process, Process configurations. **Adsorption**: Introduction, Fundamentals of adsorption, Type of adsorbents Development of adsorption, Activated carbon adsorption, Granular carbon adsorption. Membrane Filtration, Membrane Process Terminology Membrane Process Classification and operation: Microfiltration, Ultra filtration, Nano filtration, Reverse Osmosis, Electro dialysis Membrane Configurations: Microfiltration, Ultra filtration.	15
II	**Ion Exchange:** Fundamentals of Ion Exchange Types of Ion Exchange Resins Theory of Ion Exchange Applications: Removal and recovery of heavy metals, Removal of nitrogen, Removal of phosphorus, Organic chemical removal **Electrochemical:** Introduction Electro-coagulation: Factors affecting Electro coagulation, Electrode materials, Electro-floatation: Factors affecting electro floatation Comparison with other technology. **Electro-oxidation:** Electro oxidation process, Reactor configurations, Advanced Oxidation Processes, Theory of advanced oxidation, Types of oxidizing agents, ozone based and non-ozone based processes, Fenton and Photo-Fenton Oxidation, Solar Photo Catalytic Treatment Systems.	15

Text Books:

- S.K. Garg Water Supply Engineering (Environmental Engineering Vol.-I) New Delhi: Khanna Publishers; 2008.
- S.K. Garg Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol.-II) New Delhi: Khanna Publishers; 2008.

Reference Books:

- H.T. Mann and D. Williamson Water Treatment and Sanitation – Simple Method for Rural Area London, UK Intermediate Technology Publications; 1982.
- B.C. Punmia Water Supply and Wastewater Engineering Vol. I and II New Delhi: Laxmi Publications; 2010.
- D. Srinivasan Environmental Engineering New Delhi: PHI Learning Pvt. Ltd; 2009.
- E.W. Steel and T.J. McGhee Water Supply and Sewerage New York USA: McGraw-Hill; 1991.
- E.G. Wanger and J.N. Lanoix Water Supply for Rural Areas and Small Communities Geneva: WHO; 1991.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand basic features of Advanced water treatment technologies.
- CO2: Analyze Different Techniques available for water and waste water treatment
- CO3: Evaluate physicochemical methods of water treatment
- CO4: Learn about the different advanced technologies available water management

- CO5: Understand different mechanism of water pollution control

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

BCEE 0805: APPLIED HYDROLOGY LabORATORY

Objective: *To strengthen the existing monitoring systems for water availability, monitoring of water use and would put much emphasis on IWRM and real-time monitoring and flow forecasting.*

Credits: 01 **L-T-P: 0-0-2**

Module No.	Content	Teaching Hours
I	• Measurement of Coordinates using GPS receiver • Various Open Data Sourcing • Geo-referencing of Satellite Image using GIS software • Shape file creation and Attribute table date entry using GIS software. • Digitization of physical features on a map/image using GIS software. • Preparation of Base Maps • Testing of Water Samples through field water testing kit • Stream Network Delineation using GIS Software • Watershed Delineation using GIS Software • Hydrological Modeling. • Flood Analysis • Precipitation Data Analysis	**20**

Text Books:

- M. Anji Reddy, *Textbook of Remote Sensing and Geographical Information systems*. Hyderabad: BS Publications; 2011
- M. Lillesand Thomas, W. Kiefer Ralph, W. *Chipman* Jonathan *remote sensing and image interpretation*. John Wiley & Sons; 2008

Reference Books:

- Kang tsung Chang. *Introduction to Geographical Information System*. U.S.A: Tata McGraw Hill, 7th edition; 2010
- A.M. Chandra and S.K. Ghosh. *Remote Sensing and Geographical Information system*. New Delhi: Narosa Publishing House; 2006

Focus: This course focuses on Skill development aligned with CO3 and CO1

Outcome: After completion of course, the student will be able to:

- *Understand the Practical Use of GPS Receiver*
- *Learn to Digitization, Geo-referencing, and image classification*
- *Relate Rainfall-Runoff Data*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1

BCEE 0806: EXPERIMENTAL ANALYSIS OF CLIMATE

Objective: *To learn different measurement analysis of Climate*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I	• Measurement of earth coordinates using GPS receiver. • Study of Various Open Data Source GIS for Climate change analysis • Geo-referencing of Satellite Image using GIS software. • Different Shape file creation and Attribute table date entry using GIS software. • Study of different features of earth surface in remote sensing Imagery using Remote sensing Software. • Digitization of physical features on a map/image using GIS software for Environmental & Climate analysis • Study of atmospheric parameters and prepare a plan to measure these parameters. • Study of atmospheric processes and their short term and long term affect • Study and explain how climate has changed naturally in the past and how it is now changing because of human influences • Describe and explain ozone depletion in the atmosphere. • Apply the concept of feedback mechanisms to specific examples of climate change • Study of the factors influencing the temperature and precipitation patterns on Earth • Collection, analysis and interpretation of atmospheric and meteorological data responsible for Climate change.	20

Text Books:

- M. Anji Reddy *Textbook of Remote Sensing and Geographical Information systems* Hyderabad: BS Publications; 2011.
  A.M. Chandra and S.K. Ghosh *Remote Sensing and Geographical Information system* New Delhi: Narosa Publishing House; 2006

Reference Books:

- M. Lilles Thomas and W. Kiefer Ralph W. Chipman Jonathan *Remote sensing and image interpretation* New Delhi: John Wiley & Sons; 2008.
- Kang tsung Chang *Introduction to Geographical Information System* New Delhi: Tata McGraw Hill; 2010.

Focus: This course focuses on employability aligned with CO3 and CO4
Outcome: After completion of course, the student will be able to:

- CO1: Understand the Practical Use of GPS Receiver
- CO2: Learn to Digitization, Geo-referencing, and image classification
- CO3: Learn to collect atmospheric and meteorological data
- CO4: Understand process of formulation of climate models
- CO5: Understand different climate change parameters

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

BCEE 0807: ADVANCED WATER TREATMENT TECHNOLOGIES LABORATORY

Objective: *To learn different advanced water and waste water analysis laboratory experiment*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I	• Determination of Phosphate • Determination of copper. • Determination of Residual Chlorine • Determination of Most Probable Number of Coli forms • Measurement of Air Pollutants with respirable dust sampler • Determination of Total Suspended and Dissolved Solids • Determination of BOD • Determination of COD using Spectrophotometer • Determination of Kjeldahl Nitrogen • Determination of Fluoride • Determination of Nickel • Determination of Chlorides • Determination of ozone • Determination of Dissolved Oxygen	20

Text Book:

- S. K. Garg "*Water Supply Engineering*" [Vol. I & II] NewDelhi: Khanna Publishers; 2008.

Reference Books:

- M. L. Davis and D. A. Cornwell "*Introduction to Environmental Engineering*" 4th Ed. Boston: McGraw-Hill; 2008.
- S. K. Garg "*Water Supply Engineering*" [Vol. I & II] NewDelhi: Khanna Publishers; 2008.

Focus: This course focuses on Skill development aligned with CO3 and CO2
Outcome: After completion of course, the student will be able to:

- CO1:Understandthemethods of analysis of water
- CO2: Fundamentals of physical,chemicaland biological water qualityparameters.
- CO3: Develop basic know about the instruments used for water analysis.
- CO4: Understand the Different aspects of advanced Waste water analysis

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1

BCEE 0301: RAILWAY ENGINEERING

Objective: *The aim of the course is to impart the knowledge of planning, design, construction, and maintenance of railway tracks.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Railway Engineering:** History of Railway, Role of railways in transportation system, railways and highways comparisons; classification of Indian railways, railway zones in India, railway gauges, creep, coning of wheels and traction resistance **Permanent ways:** Rail & rail joints (welding of rails, LWR, SWR, CWR), failures in rails, Sleepers, Ballast, Formation and its drainage, track fitting and fastening. **Geometric design of railway track:** Alignment and grades, cross section and its elements (at filling & cutting), grade compensation, cant and cant deficiency, negative cant and widening of gauges on curves, curves used for railway track (horizontal and vertical curves).	20
II	**Stresses** in railway tracks. **Points and Crossings:** Elements of A Simple Turn-Out, Details of Switch, Details of Crossings, Number and Angle of Crossings, Geometric Design of Turn-Out. **Stations and Yards**: Site Selection for A Railway Station, Layout of Different Types of Stations, Classification of Stations, Types of Railway Yard, **Signaling and Interlocking**: Classification of Signals, Absolute Block System.	20

Text Books:

- S.P. Arora, and S.C. Saxena, Railway *Engineering*, New Delhi, Dhanpat Rai Publications, (2006).
- S. Chandra, and M.M Agarwal *Railway Engineering*, New Delhi Oxford University Press, (2008).

Reference Book:

- S.K. Khanna, M.G. Arora, and S.S. Jain, "*Airport Planning and Design"* Roorkee Nem Chand and Bros, (1994).

Focus: This course focuses on employability aligned with CO3 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand the importance of railway network in India and its organizational structure.
- CO2: Learn about rail joints, failures in rails and structural components of railway tracks.
- CO3: Design the geometrical parameters of railway tracks.
- CO4: Design the points and crossings used by Indian Railways.
- CO5: Describe the classification of railway stations and yards and their layouts.
- CO6: Define type of Signal systems used by Indian railways.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO4
CO2	PO1,PO2 /PSO4
CO3	PO1,PO2 /PSO4
CO4	PO1,PO2,PO3 /PSO4
CO5	PO1,PO2 /PSO4

CO6	PO1,PO2 /PSO4

BCEE 0302: BASICS OF TRANSPORTATION SYSTEM AND PLANNING

Objective: *To introduce with design steps of Transportation System and its planning, familiarize with the modern advances in Transportation system.*

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Overview of Transportation System, Nature of Traffic Problems in Cities, Present Scenario of Road Transport. Role of Transportation: Social, Political, Environmental; Goals and Objectives of Transportation Planning. **Type of Transportation System:** Intermediate Public Transport (IPT), Public Transport, Rapid and Mass Transport System. **Travel Demand:** Introduction to Four Stage Models: Trip classification, Trip generation, Trip Distribution,	15
II	**Travel Demand:** Modal Split and Trip Assignment. **Transportation Facilities:** Pedestrian Facilities, Bicycle Facilities, Parking Facilities, Transport System Management, Long Term and Short Term Planning, Use of IT In Transportation (ITS).	15

Text Book:

- L.R. Kadiyali *Traffic Engineering and Transport Planning* New Delhi: Khanna Publishers; 2008

Reference Books:

- Dickey J. W. Metropolitan Transportation Planning UK: Taylor & Francis; 1983.
- W. W Hay, Introduction to Transportation Engineering New York, USA: John Wiley and Sons; 2003.
- E. K Mortak Introduction to Transportation Engineering and Planning New York, USA: McGraw Hill Publication; 2001.

Focus: This course focuses on employability aligned with CO4 and CO1

Outcome: On successful completion of this course, the students shall be able to:

- CO1: State the traffic problems associated with cities and role of transportation system.
- CO2: Describe type of transportation systems and their properties.
- CO3: Learn Four stage modelling for travel demand.
- CO4: Explain the standards required for the construction of pedestrian, bicycle and parking facilities.
- CO5: Describe the importance of long term planning, short term planning and use of ITS in transportation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6, PO7, PO12 / PSO4
CO2	PO1, PO2, PO12 / PSO4
CO3	PO1, PO2, PO3, PO4, PO5, PO12 / PSO4
CO4	PO1, PO2, PO3, PO4, PO6, PO12 / PSO4
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12/ PSO4

BCEE 0303: AIRPORT PLANNING AND DESIGN

Objective: *This course also helps in the development of skills on airport planning and design with the prime focus on runway and taxiway geometrics.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Aircraft characteristics:** Aircraft characteristics related to airport design; Airport configuration – Runway configurations, Relation of terminal area to runways, Runway orientation, Wind rose diagram. **Geometric design of the airfield:** ICAO and FAA design standards, Runways, Taxiways, Holding aprons and aprons	20
II	**Planning and design of the terminal area:** Apron-gate system, Size and number of gates, Aircraft parking configurations, Passenger terminal system. **Design of Runway& Taxiways** **Airport lighting and marking** **Air traffic control:** Airport planning and air travel demand forecasting	20

Text Books:

- G.V. Rao, *Airport Planning and Design* New Delhi: Tata McGraw Hill; 1992.
- S. C. Saxena *Airport Engineering: Planning and Design* New Delhi: CBS Publications & Distributors; 2015.

Reference Book:

- Khanna and Arora *Airport Planning and Design* New Delhi: Dhanpat Rai & Sons; 2015.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4
Outcome: After completion of course, the student will be able to:

- CO1: Describe characteristics of aircraft affecting the design of airport.
- CO2: Design the orientation of the Runway and runway length.
- CO3: Explain the standards for the design of runway, taxiway and aprons.
- CO4: Sketch the aircraft parking configuration and terminal area.
- CO5: Explain all kind of runway lighting and markings.
- CO6: Assess the future air travel demand.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO4
CO2	PO1,PO2,PO3 /PSO4
CO3	PO1,PO2 /PSO4
CO4	PO1,PO2 /PSO4
CO5	PO1,PO2 /PSO4
CO6	PO1,PO2 /PSO4

BCEE 0304: BASICS OF TRAFFIC ENGINEERING

Objective: *To introduce students with the basics of Traffic engineering, regulations and safety.*

Credits:03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Traffic Survey: Speed, Vehicle Volume counts, O-D survey, Use of Photographic Technique in Traffic survey, Elements of Parking survey Analysis, Statistical Methods of Traffic Engineering. **Fundamentals of traffic flow:** Traffic flow elements, gap and gap acceptance, Introduction to highway capacity analysis.	15
II	**Traffic operation and Controls:** Traffic signs, Road marking, Traffic signals and its design. **Traffic Regulations:** Regulation of traffic, Traffic regulation at Controlled and uncontrolled intersections, at grade and grade separated intersections. **Traffic Safety:** Road accidents, Causes and Prevention, Street Lighting and Traffic management, Traffic calming techniques.	15

Text Book:

- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.

Reference Books:

- S. K. Khanna and C. E. G. Justo *Highway Engineering* Roorkee : Nemchand Bros.;2001.
- C. J Khisty & B. K. Lall *Transportation Engineering,* New Delhi: Prentice Hall of India; 2002.

Focus: This course focuses on employability aligned with CO3 and CO5

Outcome: On successful completion of this course, the students shall be able to:

- CO1: Mention speed survey, volume survey, O-D survey, Photographic traffic survey to collect the traffic data.
- CO2: Describe traffic flow elements from the traffic data.
- CO3: Summarize the need of the traffic signs, signals and road markings.
- CO4: Identify the components of controlled intersections, uncontrolled intersections, At grade intersections and grade separated intersections.
- CO5: Assess the road accidents and their causes, along with their prevention methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6 / PSO4
CO2	PO1, PO2, PO5, PO12 / PSO4
CO3	PO1,PO6, PO12 / PSO4
CO4	PO1, PO6, PO7 / PSO4
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO11, PO12/ PSO4

BCEE 0305: CONSTRUCTION TECHNOLOGY & MANAGEMENT

Objective: *The objective of this course is to develop an understanding of the basics of project management, structure of project organization and various stakeholders involved in a project. This course also enables the learner to practice the various methods of construction planning, project scheduling and resource allocation along with a brief introduction about the contract estimation and construction management.*

Credits: 03 **L-T-P-J: 2-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Phase of project, project management and its relevance, stakeholders of a project, structure of project organization, management levels, and traits of a project manager. **Construction Planning:** Introduction, activities involved types of project plan, work breakdown structure. Planning terminologies, Critical path method, forward and backward pass, PERT, Ladder network, Precedence network, Line of balance. **Project scheduling and resource leveling:** Introduction, Resource allocation and leveling for unlimited resources, Resource allocation for limited resources, Multi resource allocation, Optimal scheduling.	15
II	**Contracts Estimation and Bidding Strategy:** Introduction, Determination of bid price, Bidding models. Project Monitoring and Control: Introduction, Project updating, Cost control. **Construction Management:** Construction Equipment and Management, Construction Account Management, Construction Material management, Construction Quality Management, Construction Safety Management, Computer Application In Construction Management, Workforce Motivation And Human Factors In Construction Management, Plant Management, Project Communication.	15

Text Books:
- P.S. Gahlot and B.M. Dhir "Construction Planning and Management" New Delhi: New Age International (P) Ltd. Publishers; 2007.
- S.P. Arora and S.P. Bindra "A Text Book of Building Construction including Engineering Materials" New Delhi: Dhanpat Rai Publications (P) Ltd.; 2005.

Reference Books:
- M. T. Callahan, D. G. Quackenbush and J. E. Rowings Construction Project Scheduling New York: McGraw-Hill; 1992.
- D. I. Cleland and L. R. Ireland Project Management: Strategic Design and Implementation 4th Edition New York: McGraw-Hill; 2002.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcomes: After completion of course, the student will be able to:
- CO1: Prepare work breakdown plan and estimate resources requirements.
- CO2: Solve problems of resource allocation and levelling using network diagrams.
- CO3: Plan and develop management solutions to construction projects.
- CO4: Understand the principles of project management, resource management and inventory.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO3
CO2	PO1,PO2,PO3/PSO3

CO3	PO1,PO11/PSO3
CO4	PO11/PSO3

BCEE 0306: TRANSPORTATION SYSTEM AND PLANNING

Objective: *To be able to design Transportation System based on travel demand and to familiarize with the modern advances in Transportation system.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Overview of Transportation System, Nature of Traffic Problems in Cities, Present Scenario of Road Transport. Role of Transportation: Social, Political, Environmental; Goals and Objectives of Transportation Planning. **Type of Transportation System:** Intermediate Public Transport (IPT), Public Transport, Rapid and Mass Transport System. **Travel Demand:** Design of transportation system using Four Stage Models: Trip classification, Trip generation, Trip Distribution,	15
II	**Travel Demand:** Modal Split and Trip Assignment. **Evaluation of Transport Planning Proposals:** Economic Evaluation Methods - Net Present Value Methods, Benefit Cost Method, Internal Rate of Return Method. **Transportation Facilities:** Pedestrian Facilities, Bicycle Facilities, Parking Facilities, Transport System Management, Long Term and Short Term Planning, Use of IT In Transportation (ITS).	15

Text Book:
- L. R. Kadiyali Traffic Engineering and Transport Planning New Delhi: Khanna Publishers; 2008.

Reference Books:
- Dickey, J. W. *Metropolitan Transportation Planning* UK Taylor & Francis; 1983.
- W. W. Hay, *Introduction to Transportation Engineering* New York: USA John Wiley and Sons; 2003.
- E. K. Mortak *Introduction to Transportation Engineering and Planning* New York USA: McGraw Hill Publications; 2001.

Focus: This course focuses on employability aligned with CO5 and CO4

Outcome:
On successful completion of this course, the students shall be able to:
- CO1: Understand the traffic problems associated with cities and role of transportation system.
- CO2: Describe type of transportation systems and their properties.
- CO3: Learn and Compute four stage modelling for travel demand.
- CO4: Evaluate transportation planning projects on the basis of economics.
- CO5: Describe the importance of long term planning, short term planning and use of ITS in transportation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6, PO7, PO12 / PSO4
CO2	PO1, PO2, PO12 / PSO4
CO3	PO1, PO2, PO3, PO4, PO5, PO12 / PSO4
CO4	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11, PO12 / PSO4

CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12/ PSO4

BCEE 0307: ADVANCE TRAFFIC ENGINEERING

Objective: *To introduce students with the basics of Traffic engineering, regulations and safety and to perform traffic study.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Traffic Survey: speed, Journey and Delay Surveys, Vehicle Volume counts, O-D survey, Use of Photographic Technique in Traffic survey, Elements of Parking survey Analysis, Statistical Methods of Traffic Engineering. **Fundamentals of traffic flow:** Traffic flow elements, gap and gap acceptance, highway capacity analysis.	15
II	**Traffic operation and Controls:** Traffic signs, Road marking, Traffic signals and its design. **Traffic Regulations:** Regulation of traffic, Design of Controlled and uncontrolled intersections, at grade and grade separated intersections. **Traffic Safety:** Road accidents, Causes and Prevention, Road safety audit Street Lighting and Traffic management, Traffic calming techniques, Detection of crash	15

Text Book:

- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.

Reference Books:

- S. K. Khanna and C. E. G. Justo *Highway Engineering* Roorkee: Nemchand Bros.; 2001.
- C. J Khisty & B. K. Lall *Transportation Engineering* New Delhi: Prentice Hall of India; 2002.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: On successful completion of this course, the students shall be able to:

- CO1: Conduct the speed survey, volume survey, journey and delay survey, O-D survey, Photographic traffic survey to collect the traffic data.
- CO2: Compute traffic flow elements from the traffic data.
- CO3: Judge the need of the traffic signs, signals and road markings.
- CO4: Design the components of controlled intersections, uncontrolled intersections, At grade intersections and grade separated intersections.
- CO5: Assess the road accidents and their causes, along with their prevention methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO4, PO5, PO6, PO9, PO12 / PSO4
CO2	PO1, PO2, PO3, PO5, PO12 / PSO4
CO3	PO1,PO2, PO3, PO4, PO5, PO6, PO12 / PSO4
CO4	PO1, PO2, PO3, PO6, PO7 / PSO4
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO11, PO12/ PSO4

BCEE 0314: TRAFFIC ENGINEERING

Objective: *To introduce students with the basics of Traffic engineering, regulations and safety.*

Credits:03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Traffic Survey: Speed, Vehicle Volume counts, O-D survey, Use of Photographic Technique in Traffic survey, Elements of Parking survey Analysis, Statistical Methods of Traffic Engineering. **Fundamentals of traffic flow:** Traffic flow elements, gap and gap acceptance, Introduction to highway capacity analysis.	15
II	**Traffic operation and Controls:** Traffic signs, Road marking, Traffic signals and its design. **Traffic Regulations:** Regulation of traffic, Traffic regulation at Controlled and uncontrolled intersections, at grade and grade separated intersections. **Traffic Safety:** Road accidents, Causes and Prevention, Street Lighting and Traffic management, Traffic calming techniques.	15

Text Book:

- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.

Reference Books:

- S. K. Khanna and C. E. G Justo. *Highway Engineering* Roorkee: Nemchand Bros.; 2001.
- C. J Khisty & B. K. Lall *Transportation Engineering,* New Delhi: Prentice Hall of India; 2002.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: On successful completion of this course, the students shall be able to:

- CO1: Mention speed survey, volume survey, O-D survey, Photographic traffic survey to collect the traffic data.
- CO2: Describe traffic flow elements from the traffic data.
- CO3: Summarize the need of the traffic signs, signals and road markings.
- CO4: Identify the components of controlled intersections, uncontrolled intersections, At grade intersections and grade separated intersections.
- CO5: Assess the road accidents and their causes, along with their prevention methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6 / PSO4
CO2	PO1, PO2, PO5, PO12 / PSO4
CO3	PO1,PO6, PO12 / PSO4
CO4	PO1, PO6, PO7 / PSO4
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO11, PO12/ PSO4

BCEE 0800: COMPUTER AIDED ESTIMATION AND PLANNING LABORATORY

Objective: *This course gives an exposure to students in utilizing the sophisticated spread sheets programs, estimation software and other package programs.*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Contents	Teaching Hours
I/II	• Quantity takeoff, Preparation and delivery of the bid or proposal of an engineering construction project. • Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking. • Scheduling of a small construction project using Primavera scheduling systems including reports and tracking. • Simulation models for project risk analysis	20

Reference Books

- Paulson. B.R., Computer Applications in Construction, McGraw Hill, 2005.
- Krishnamoorthy .C.S and Rajeev .S, Computer Aided Design, Narosa publishing house, New Delhi, 2001.
- Feigenbaum .L, Construction Scheduling with Primavera Project Planner, Prentice Hall Inc., 2009.

Focus: This course focuses on Skill development aligned with CO1 and CO2

Course Outcomes:

- Prepare delivery of Bid or proposal of engineering project
- Perform scheduling of constructions projects using tools primavera and MS projects.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO7/PSO4
CO2	PO7/PSO4

BCEE 0808: TRAFFIC SIMULATION AND ANALYSIS LABORATORY

Objective: *To impart knowledge of traffic simulation and evaluate the results. Also to create cross section design of highways.*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I/II	VISSIM • Introduction to the Traffic Simulation • Introduction of VISSIM Software • Basic commands of VISSIM • Modelling of road sections • Modelling of Unsignalised Intersection • Modelling of Signalised Intersection • Modelling of Rotary Intersection • Modelling of Grade Separated IntersectionOpen Roads • Introduction to basic commands of Open Roads • Drafting the components of Road	20

Text Books:
- VISSIM 5.30-05 User Manual
- *https://communities.bentley.com/products/road.../video-replace-reference*

Reference Books:
- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.
- S. K. Khanna and C. E. G Justo. *Highway Engineering* Roorkee: Nemchand Bros.; 2001.
- C. J Khisty & B. K. Lall *Transportation Engineering* New Delhi: Prentice Hall of India; 2002.

Focus: This course focuses on Skill development aligned with CO3 and CO4
Outcome: After completion of course, the student will be able to:
- CO1: Understand the Traffic simulation and drawings of road
- CO2: Perform the Traffic simulation analysis
- CO3: Evaluate the simulation results
- CO4: Create drawing for highway cross sections

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6, PO9, PO12 /PSO4
CO2	PO1, PO2, PO6, PO9, PO12 /PSO4
CO3	PO1, PO2, PO3, PO6, PO9, PO12 /PSO4
CO4	PO1, PO6, PO9, PO12 /PSO4

BCEE 0809: TRAFFIC ENGINEERING LABORATORY

Objective: *To impart knowledge of traffic studies and interpretation of the results.*

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I/II/III	• Traffic Volume Study • Spot speed study • Photographic survey to collect traffic data • Analysis and modeling of urban signalized networks • Analysis and estimation of signalization, delays, queuing • Traffic capacity and level of service estimation in highways • Analysis of pedestrian traffic • Traffic safety analysis • Investigation of hazardous locations • Design and operation of parking systems	20

Text Book:
- IRC:SP: 19-2001, *Manual for Survey, Investigation and Preparation of Road Projects,* IRC Code (2001)

Reference Books:
- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.
- S. K. Khanna and C. E. G. Justo *Highway Engineering* Roorkee: Nemchand Bros.; 2001.

Focus: This course focuses on Skill development aligned with CO2 and CO4
Outcome: After completion of course, the student will be able to:
- CO1: Define traffic collection methods
- CO2: Conduct the speed survey, volume survey, journey and delay survey, O-D survey, Photographic traffic survey to collect the traffic data.
- CO3: Analyse the Signalised intersection, LOS, Pedestrian traffic
- CO4: Identify hazardous locations for traffic

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO4
CO2	PO1, PO2, PO6, PO12 /PSO4
CO3	PO1, PO2, PO3, PO6, PO9, PO12 /PSO4
CO4	PO1, PO2, PO3, PO6, PO9, PO12 /PSO4

COURSE STRUCTURE

M.TECH.

STRUCTURAL ENGINEERING

Under

Choice Based Credit System (CBCS)

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCEC 1001	Advanced Mechanics of Solids	4	0	0	4	4
2	MCEC 1002	Advanced Structural Analysis	4	0	0	4	4
3	MCEC 1004	Numerical Analysis & Computer Programming	4	0	0	4	4
4	MCEC 0005	Structural Dynamics	4	0	0	4	4
5	MCEC 0009	Design of Prestress Concrete Structures	4	0	0	4	4
PRACTICALS							
1	MCEC 0801	Cad Laboratory-I	0	0	2	1	2
		TOTAL	**20**	**0**	**2**	**21**	**22**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCEC 0006	Finite Element Method	4	0	0	4	4
2	MCEC1007	Advanced Concrete Design	4	0	0	4	4
3	MCEC 1008	Earthquake Resistant Design	4	0	0	4	4
4	MCEC 0010	Advanced Concrete Technology	4	0	0	4	4
5		Elective-I	4	0	0	4	4
PRACTICALS							
1	MCEC1800	Concrete Technology Laboratory	0	0	2	1	2
		TOTAL	**20**	**0**	**2**	**21**	**22**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCEC 0011	Introduction to Bridge design	4	0	0	4	4
2	MCEC 0012	Construction Management And Equipments	4	0	0	4	4
3	MCEJ 0971	Dissertation-I	0	0	0	6	0
PRACTICALS							
1	MCEC 0802	Cad Laboratory-II	0	0	2	1	2

		TOTAL	**8**	**0**	**2**	**15**	**10**

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCEJ-0972	Dissertation –II	0	0	0	14	0
		TOTAL	**0**	**0**	**0**	**14**	**0**

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCEE 0003	Non-Conventional Construction Materials & Elements	4	0	0	4	4
2	MCEE 0004	High Rise Structures	4	0	0	4	4
3	MCEE 0005	Durability Assessment and Structural Strengthening of Reinforced Concrete	4	0	0	4	4
4	MCEE 0006	Experimental Stress Analysis	4	0	0	4	4
5	MCEE 0007	Soft Computing Methods for Civil Engineering	4	0	0	4	4
6	MCEE 0008	Optimization Methods in Civil Engineering	4	0	0	4	4
7	MCEE 0009	Soil Structure Interaction	4	0	0	4	4
8	MCEE 0010	Theory of Plates and Shells	4	0	0	4	4
9	MCEE 0012	Retrofitting of Structures	4	0	0	4	4
10	MCEE 0013	Advanced Design of Metal Structures	4	0	0	4	4
11	MCEE 0014	Design of Offshore and Marine Structures	4	0	0	4	4

MCEC 1001: ADVANCED MECHANICS OF SOLIDS

Objective: The objective of this course is to impart of the basic principles of the continuum mechanics namely theory of elasticy, plasticity and visco elasticity enabling to analyses and design structures obeying complicated constitutive relationship etc.

Credits:04 **L-T-P:4-0-0**

Module No.	Contents	Teaching Hours
I	Introduction, Stress and Strains in 3-D – Cauchy formula, Principal Stress, hydrostatic stress, deviatoric stress, stress transformations, Mohr circle, octahedral shear stress, strain energy densities, etc. Theories of failure, Beam on elastic foundations, bending of curved beams – Crane Hooks & Chains, Torsion of Non-circular members, hollow members, thin walled sections; Membrane Analogy, Columns Straight & initially curved columns, Rankine formula	20
II	Energy Methods – Energy Theorems, Use of energy theories for calculating deflections, twists, solution to torsion (non-circular) problems, Unsymmetrical bending, shear centre, Introduction to Photo-elasticity.	20

Reference Books:

1. "Mathematical Theory of Elasticity" by I. S. Sokolnikoff(1941).
2. "Advanced Machanics of Materials" by Boresi(2011).
3. "Theoretical Elasticity" by A. E. Green and W. Zerna(1968).
4. "Theory of Elasticity" by Timoshienko(1934).
5. "Advanced Strength and Applied Elasticity" by A. C. Ugural and S. K. Fenster(2003)
6. "Applied Elasticity" by R.T. Fenner(1988).
7. "Advanced Strength of Materials" by L. S. Srinath(2000)

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1:Analyzethe continuum based ontheory of elasticity plasticity and visco elasticity and
- CO2:Application of theory of elasticity plasticity and visco elasticity to specific problems.
- CO3:applications to specific problems and their field applications
- CO4:applications to engineering and research based complicated problems.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2

MCEC 1002: ADVANCED STRUCTURAL ANALYSIS

Objective: The objective of this course is to develop a computer program for structural analysis based on the matrix stiffness, analyses the general stiffness and flexibility method and apply it to solve indeterminate structures, etc.

Credits: 04 **L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	**Review of basic concepts in structural analysis:** **structure** (structural elements, joints and supports, stability, rigidity and static indeterminacy, kinematic indeterminacy); **loads** (direct actions, indirect loading); **response** (equilibrium, compatibility, force-displacement relations); Review of analysis of Indeterminate structures Force and displacement methods Mathematical preliminaries, Review of concept of matrix algebra; stiffness and flexibility matrices **Matrix analysis of structures with axial elements**: Introduction: Axial stiffness and flexibility; stiffness matrices for an axial element (two dof), plane truss element (four dof) and space truss element (six dof);One-dimensional axial structures: Analysis by stiffness method (two dof per element) Plane trusses: Analysis by stiffness method (four dof per element) **Matrix analysis of beams and grids:** stiffness method for beams: Stiffness method for grids:	22
II	**Matrix analysis of plane and space frames:** stiffness method for plane frames: Element stiffness (six dof); generation of structure stiffness matrix and solution procedure; dealing with internal hinges and various end conditions **Stiffness method for space frames**: Introduction; element stiffness matrix of space frame element Implementation issues	18

Text Books:

1. Devdas Menon,"Advanced StructuralAnalysis", Narosa Publishing House, 2009.
2. Asslam Kassimali,"Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Amin Ghali,Adam M Neville and Tom G Brown,"Structural Analysis:A Unified Classical and Matrix Approach",Sixth Edition, 2007, Chapman & Hall.

Reference Books:

1. Devdas Menon,"StructuralAnalysis", Narosa Publishing House, 2008.

Focus: This course focuses on employability aligned with CO3 and CO6
Outcome: After completion of course, the student will be able to:

- CO1: Understand and can descritize the problem
- C02 Develop the member or element stiffness matrix for different structural elements
- C03 Able to convert the member loads to equivalent joint loads
- C04 Apply the boundary conditions for different problems
- C05 Analyze the complete problem of truss, beam, Plane frame and grid

- C06 Develop simple program in MATLAB

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PSO3 /PSO1, PSO2
CO2	PO1,PO2/PSO2
CO3	PO1,PO2/PSO2
CO4	PO1,PO2,PO3/PSO2
CO5	PO1,PO3/PSO2
CO6	PO1,PO2/PSO1. PSO2

MCEC 1004: NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING

Objective: The objective of this course is to impart numerical techniques in analysis of complex real problem dealing with Transcendental, polynomial linear nonlinear equation, ODE, PDE, Numerical Integration with the help of computer.

Credits: 04 **L-T-P-: 4-0-0**

Module No.	Content	Teaching Hours
I	Computation and Error Analysis Accuracy and precision; Truncation and round-off errors; Binary Number System; Error propagation Linear Systems and Equations: Matrix representation; Cramer's rule; Gauss Elimination; Matrix Inversion; LU Decomposition; Iterative Methods; Relaxation Methods; Eigen Values Algebraic Equations: Bracketing methods: Bisection, Reguli-Falsi; Open Methods and Optimization: Secant, Fixed point iteration, Newton-Raphson; Multivariate Newton's method NOTE:- Excel spread sheets	20
II	Numerical Differentiation Numerical differentiation; higher order formulae Regression Linear regression; Least squares; Total Least Squares; Interpolation and Curve Fitting Interpolation; Newton's Difference Formulae; Cubic Splines ODEs: Initial Value Problems, : ODEs: Boundary Value Problems NOTE:- Excel spread sheets	20

Text Books:

1. 1 Chapra, S. C. and Canale R. P., "Numerical Methods for Engineers", Tata McGraw hill(2012).
2. Carnahan, B., Luther, H. A. and Wilkes, J. O., "Applied Numerical Methods", John Wiley(1972).
3. Heath, M. T. ,"Scientific Computing : An Introductory Survey", McGraw hill(1946).

Refrence books:

1. 1 Douglas Faires, J. and Richard Burden, "Numerical Methods", Thomson(2012).
2. Rajasekaran, S., "Numerical Methods in Science and Engineering", S. Chand(2003).

Focus: This course focuses on employability aligned with CO5 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Identify different mathematical problems and reformulate them in a way that is appropriate for numerical treatment
- C02 Apply various interpolation methods and finite difference concepts
- C03 Work out numerical differentiation and integration whenever and wherever routine methods are not applicable
- C04 Choose appropriate numerical method for treatment of the given problem
- C05 Explain choice of method by accounting for advantages and limitations
- C06 Develop simple program in MATLAB

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PSO2 /PSO1
CO2	PO1,PO2/PSO2
CO3	PO1,PO2/PSO2
CO4	PO1,PO2,PO3/PSO2
CO5	PO1,PO3/PSO2
CO6	PO1,PO2/PSO1. PSO2

MCEC 0005: STRUCTURAL DYNAMICS

Objective: *The objective of this course is to develop fundamentals about various dynamic problems of complex nature and response of structures to these conditions.*

Credits: 04 **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Types of dynamic loads, Basic background of methods available and motivation for structural dynamics **Dynamics of Single Degree-of-Freedom Structures**: Dynamic equation of equilibrium, Free vibration of single degree of freedom systems, Forced vibration: harmonic and periodic loadings, Dynamic response functions, force transmission and vibration isolation, SDOF response to arbitrary functions **Numerical Evaluation of Dynamic Response of SDOF Systems:** Time domain analysis: finite difference methods, Frequency domain analysis: basic methodology **Earthquake Response of SDOF Systems**: Earthquake excitation, response history and construction of response spectra, Response spectrum characteristics, tripartite plot, and design spectrum. **Multi Degree of Freedom Systems - Basics:** Dynamic equations of equilibrium, static condensation, Symmetric plan and plan-asymmetric systems.	20
II	**Free Vibration Response of MDOF Systems:** Un damped systems: natural modes and their properties, Numerical solution for the eigen value problem, Solution of free vibration response for un damped systems, Free vibration analysis of systems with damping. **Dynamic Analysis of Linear MDOF Systems**: Introduction, modal analysis, Response-history for earthquake excitations using modal analysis, Response spectrum analysis for peak responses, Concept of Caughey damping as a general type of proportional damping. **Generalized Single Degree of Freedom Systems**: Basic concepts, mass-spring system, Lumped mass systems, Systems with distributed mass and elasticity, Rayleigh's method, shape function selection.	20

Reference Books:

- Introduction to Structural Dynamics – J. M. Biggs(2010).
- Elements of Earthquake Engineering – Jai Krishna and A. R. Chandra sekharan (1976).
- Soil Dynamics – Shamsher Prakash (1981).
- Dynamics of Structures – R.W.Clough & J.Penzien(2003).
- Earthquake Resistant Design of Structure – Pankaj Agarwal & Manish Srikhande (2006)
- Structural Dynamics – Mario Piaz (2013)
- Dynamics of Structure – Anil K Chopra (2011)

Focus: This course focuses on employability aligned with CO5 and CO6

Outcomes: After completing this course the students will be able to

- CO1: Recall the fundamental knowledge of dynamics and its application in the field of structures.
- CO2: Establishing dynamic equilibrium, the equation of motion
- CO3: Develop the background required for design of structures subjected to various forms of dynamic loadings including Earthquake and Blast.

- CO4: Implement of the establishment of dynamic equilibrium, the equation of motion
- CO5: Examine the eigen value problem and knowledge to its properties.
- CO6: Demonstrate degrees of freedom for single and multi degree of freedom systems.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

MCEC 0009: DESIGN OF PRESTRESSED CONCRETE STRUCTURES

Objectives:

- To become familiar with professional and contemporary issues in the design and fabrication of prestressed concrete members.
- Be able to identify and interpret the appropriate relevant industry design codes.
- Be able to perform analysis and design of prestressed concrete members and connections.

Credits: 04 **L-T-P-: 4-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction – theory and behavior:** Basic concepts – Advantages – Materials required – Systems and methods of prestressing – Analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensile stresses in tendons – Effect of tendon profile on deflections – Factors influencing deflections – Calculation of deflections – Short term and long term deflections – Losses of prestress – Estimation of crack width. **Design for flexure and shear**: Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per I.S.1343 Code – Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Check for strength limit based on I.S. 134 Code – Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.	20
II	**Deflection and design of anchorage zone:** Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit state of deflection. Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and IS1343 code – design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams.	20

Textbooks:

- Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012
- Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2012.

References:

- Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2002.
- Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2013
- Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
- IS1343:1980, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012

Focus: This course focuses on employability aligned with CO4 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: To understand the general mechanical behavior of prestressed concrete.
- CO2: Explain the deflection and crack control of prestressed concrete members.
- CO3: Apply the applicable industry design codes relevant to the design of prestressed concrete members.
- CO4: Examine the development length as well as prestress losses
- CO5: Evaluate the design prestressed concrete flexural members.
- CO6: To analyze and design for vertical and horizontal shear in prestressed concrete.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4, PO3
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

MCEC 0801: CAD Laboratory –I

Objective: To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design, analysis of building and Computer Aided Engineering Analysis.

Credits: 01 **L-T-P: 0-0-2**

Module No.	Content	Teaching Hours
I	1. Introduction of different Structural Engineering software. 2. Program for design of slabs using Excel. 3. Program for design of beams using Excel. 4. Program for design of column and footing using excel 5. To carry out Linear Static Analysis of Continuous Beams using analysis software. 6. To carry out Linear Static Analysis of Portal Frames using analysis software. 7. To carry out Linear Static Analysis of Truss (2D and 3D) using analysis software. 8. To carry out Linear Static Analysis of Multi-storeyed Building using analysis software.	20

Text Books:

- PangaribuanGunthar, An Introduction to Excel for Civil Engineers, Createspace Independent Pub.
- Bernd Held, Excel Functions and Formulas, BPB Publications.
- Sham Tickoo, Learning Bentley Staad.Pro V8I for Structural Analysis, Dreamtech Press.

Reference Books:

1. Sham Tickoo, Exploring Bentley STAAD.Pro V8i, BPBPublications.
2. Staad Pro V8i, Technical Reference Manual.

Focus: This course focuses on Skill development aligned CO1

Outcome: After completion of course, the student will be able to:

CO1: In this lab, students will be able to learn abilities and capabilities in developing and applying computer software and hardware to civil-structural design.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3/PSO1

MCEC 0006: FINITE ELEMENT METHOD

Objective: *1. To provide the fundamental concepts of the theory of the finite element method*
2. To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general – purpose finite element code.

Credits: 04 **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Finite Element Analysis:** Introduction Basic Concepts of Finite Element Analysis Introduction to Elasticity Steps in Finite Element Analysis **Finite Element Formulation Techniques**: Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions **Element Properties:** Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Iso parametric Formulation, Stiffness Matrix of Iso parametric Elements, Numerical Integration: One Dimensional. Numerical Integration: Two and Three Dimensional	20
II	**Analysis of Frame Structures:** Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame **FEM for Two and Three Dimensional Solids:** Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axi symmetric Element, Finite Element Formulation of Axi symmetric Element, Finite Element Formulation for 3 Dimensional Elements	20

Reference Books/ Text Book / Cases:

- Finite Element Method for Engineers and scientists – O.C.Zienkiewicz (2013).
- Numerical Methods in Finite Element Analysis – K.J.Bathe & E.L.Wilson (2014).
- Matrix Computations for Engineers & scientists – Alan Jennings(1977).
- Introduction to Finite Element Method – C.S.Desai & J.F.Abel (2001).
- Finite Element Method in Engineering – S.S. Rao (2011)

Focus: This course focuses on employability aligned with CO3 and CO6
Outcomes: On completion of this course the student will be able to

- CO1: To understand of the fundamental theory of the FEA method
- CO2: To describe the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements; to understand the application and use of the FE method for heat transfer problems.
- CO3: To demonstrate the ability to create models for trusses, frames, plate structures, machine parts, and components using ANSYS
- CO4: To demonstrate the ability to evaluate and interpret FEA analysis results for design and evaluation purposes
- CO5: To develop the ability to generate the governing FE equations for systems governed by partial differential equations

- CO6: To develop a basic understanding of the limitations of the FE method and understand the possible errors our cesinits use.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

MCEC 1007: ADVANCED CONCRETE DESIGN

Objective: *The objective of this course is to design the water retaining structures, deep beams, flat slab and long columns,*

Credits:04 **L-T-P-:4-0-0**

Module No.	Contents	Teaching Hours
I	Water tanks (Working stress method), Introduction, Circular and Rectangular tanks, Elevated circular water tank (Working stress method). Basic Design Concepts: Deflections of Reinforced concrete beams and slabs, short term deflection and long term deflection, estimation of crack width in RCC members, calculation of crack widths, Structures: Redistribution of moments, moment rotation characteristics of RC member, I.S. code provisions, and applications for fixed and continuous beam. Yield line analysis for slabs: Upper bound and lower bound theorems – yield line criterion – Virtual work and equilibrium methods of analysis for square and circular slabs with simple and continuous end conditions.	16
II	Design of Ribbed slabs, Flat slabs: Analysis of the Slabs for Moment and Shears, Ultimate Moment of Resistance, Design for shear, Deflection, Arrangement of Reinforcements. Flat slabs: Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears – Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip, Design of Reinforced Concrete Deep Beams, Strut and Tie model, Steps of Designing Deep Beams, Design by IS 456, Checking for Local Failures, Detailing of Deep Beams, Design of long columns, P-Delta effect	24

Reference Books:

- Reinforced concrete design by S. Unnikrishna Pillai & Menon, Tata Mc. Graw Hill, 2nd Edition, 2004
- Advanced Reinforced Concrete Design – P.C. Varghese, Prentice Hall of India, 2008
- Reinforced concrete , Vol.1 & 2 by H. J. Shah, Charotar publishing house Pvt. Ltd, 2011.

Focus: This course focuses on employability aligned with CO3 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Analyze &Design the reinforced concrete shallow and deep beams,
- CO2: Analyze & Designthe reinforced concrete slabs.
- CO3: Analyze & Designthe reinforced concrete compression members.
- CO4: Analyze & Designthe reinforced concrete of long columns, P-Delta effect
- CO5: Analyze & Design the reinforced concrete Water retaining structures

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2

CO4	PO1,PO2 PO3, PO4/PSO1, PSO2
CO5	PO1,PO2 PO3, PO4/PSO1, PSO2

MCEC 1008: EARTHQUAKE RESISTANT DESIGN

Objective: This course integrates information from various engineering and scientific disciplines in order to provide a rational framework for the design of earthquake-resistant structures.

Credits: 04 **L-T-P-: 4-0-0**

Module No.	Content	Teaching Hours
I	**Engineering Seismology**: Earthquake phenomenon, Causes and effects of earthquakes, Faults, Structure of earth, Plate Tectonics, Elastic Rebound Theory, Earthquake Terminology, Earthquake size – Magnitude and intensity of earthquakes, Classification of earthquakes, Seismic waves, Seismic zones, Seismic Zoning Map of India, Seismograms and Accelerograms. **Earthquake Resistant Design:** Code based seismic design methods, Equivalent lateral force method, Response spectrum method, Time history method, Soil dynamics and seismic, Spectral analysis, Nonlinear and push over analysis, Effect of plan configurations on the response of the structure.	20
II	**Codal Design Provisions**: Review of the latest Indian seismic code IS:1893: 2002 (Part-I) provisions for buildings, Earthquake design philosophy, Assumptions, Analysis by seismic coefficient and response spectrum methods, Displacements and drift requirements, Time history method. Provisions for torsion, Analysis of a multi-storey building using Seismic Coefficient method and response spectrum method. **Codal Detailing Provisions**: Review of the latest Indian codes IS: 4326 and IS: 13920 Provisions for ductile detailing of R.C buildings, Beam, column and joints. **Retrofitting and base isolation technique:** Retrofitting and strengthening of structures, Base isolation concept, isolation systems and their modeling; linear theory of base isolation, stability of elastomeric bearings; Codal provisions for seismic isolation, introduction to different types of seismic dampers	20

Text Books:

1. Agarwal, P. and Shrikhande, M. (2007), Earthquake Resistant of Design of Structures, PHI Publications.
2. Biggs, J.M. (2004), Introduction to Structural Dynamics, McGraw Hill Publications, New York, USA.
3. Chopra, A.K. (2004), Dynamics of Structures, Pearson Education, New Delhi.
4. Duggal, S.K. (2008), Earthquake Resistant of Design of Structures, Oxford University Press, New Delhi.

Reference Books:

1. IS: 1983. (1984), Criterion for Earthquake Resistant Design, Bureau of Indian Standards, New Delhi.
2. Paz, M. (1997), Structural Dynamics - Theory and Computation, Springer, New York, USA.

Focus: This course focuses on employability aligned with CO3 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Explain basic terminology in seismology, seismicity and will be able to perform simple calculations on recorded earthquake ground motions
- C02 Estimate responces of Single and Multi-Degree of Freedom System by using various methods
- C03 Apply the basic codal provisions for earthquake resistant design of structures as per Indian standards
- C04 Design and details the structure using IS 13920
- C05 Understand the concepts of Base Isolation, Seismic evaluation and retrofitting methods

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2
CO2	PO1,PO2/PSO2
CO3	PO1,PO2/PSO2
CO4	PO1,PO2,PO3/PSO2
CO5	PO1,PO3/PSO2

MCEC 0010: ADVANCED CONCRETE TECHNOLOGY

Objective: *This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high quality concrete for buildings and Infrastructure*

Credits: 04 **L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	**Cement production, composition and cement chemistry:** Importance of Bogue's compounds, Structure of a Hydrated Cement Paste, Volume of hydrated product, porosity of paste and concrete, transition Zone, Elastic Modulus, factors affecting strength and elasticity of concrete **Aggregates for concrete:** Review of types and classification; chemical composition; origin and manufacture; actions and interactions; usage; effects on properties of concretes **Chemical admixtures**: Mechanism of chemical admixture, Plasticizers and super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh cone test for optimum dosage of super plasticizer, retarder, accelerator, Air-entraining admixtures, new generation superplasticizer. **Mineral admixtures:** Fly ash, Silica fume, GCBS, and their effect on concrete property in fresh state and hardened state.	20
II	**Fresh concrete:** Rheology of concentrated suspensions, pastes, mortars and concretes; workability, segregation and bleeding. Theory and principles governing the correct placing and compaction of concrete. **Properties of hardened concrete:** Plastic settlement and plastic shrinkage; exothermic characteristics; early age thermal movements; strength development; maturity, accelerated curing Strength; deformation under load; elasticity; creep; drying shrinkage and other volume changes. Thermal properties. **Durability of concrete:** Durability concept; pore structure and transport processes; reinforcement corrosion; fire resistance; frost damage; sulfate attack; alkali silica reaction; delayed Ettringite formation; methods of providing durable concrete; short-term tests to assess long-term behaviour.	20

Reference Books:

- M. Neville, Properties of Concrete, Pearson education (2012).
- Performance Criteria for Concrete Durability, E & F N Spon, London.- J. Kroop and H.K.Hilsdorf(2004).
- Concrete Construction Engineering Hand Book, CRC Press, New York.- Edward G Nawy (2008).
- Concrete Technology, theory and Practice, S.Chand- M. S. Shetty(2000)
- Concrete Technology, Theory and Practice, McGraw Hill.- M. L. Gambhir(2013)
- Concrete, Tata Mc Graw Hill.,- P.K.Mehta & Paulo J.M.Monterio (2005)
- Advances in Cement Technology, Tech Book International, New Delhi.-S.N.Ghosh (2006).

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Course Outcomes:

- Understand the structure and properties of concrete making materials
- Discuss the concrete ingredients and its influence at gaining strength.
- Understand the durability requirements of fresh concrete
- Identify Quality Control tests hardened concrete
- Design concrete mixes as per IS codes

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO2
CO2	PO1,PO2/PSO2
CO3	PO1,PO2, PO4/PSO2
CO4	PO1,PO3/PSO2
CO5	PO1,PO2/PSO2

MCEC 1800: CONCRETE TECHNOLOGY LABORATORY

Objective: *The objective of this laboratory is gain practical idea about the behavior structural element made of construction material especially concrete and steel and design these material as per given strength criteria.*

Credits: 01 **L-T-P: 0-0-2**

Module No.	Contents	Teaching Hours
I	1. Design of Concrete mix by IS Code Method 2. Stress strain curve for concrete 3. Correlation between cube strength and cylinder strength 4. Determination of split tensile concrete 5. Relation between compressive and modulus of rupture 6. Behavior of beams under flexure 7. Durability studies on concrete (RCPT, Water Absorption, Sorpitivity, Sulphate Attack). 8. Tensile strength of different types of steel rebars, rolled steel sections. 9. Study of crack pattern developed in a simply supported beam under single point load. 10. Non-destructive tests on concrete – Rebound hammer and ultrasonic concrete test and penetration test	20

Reference Books

- Gambhir.M.L. Concrete Technology, McGraw Hill Education, 2006.
- Gupta.B.L. Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
- Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
- Santhakumar.A.R."Concrete Technology", Oxford University Press, 2007.
- Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2003

Focus: This course focuses on Skill development aligned with CO3 and CO4

Course Outcomes:

- Outline the importance of testing of cement and its properties
- Summarise the concept of workability and testing of concrete
- Describe the preparation of green concrete
- Describe the properties of hardened concrete
- Understand the non-destructive testing procedures on concrete.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO3 /PSO2
CO2	PO3/PSO2
CO3	PO4/PSO2
CO4	PO3/PSO2
CO5	PO5/PSO2

MCEC 0011: INTRODUCTION TO BRIDGE DESIGN

Objective: *The objective of this course is to introduce the learner with the basic concepts of the bridges and to enable him/her to understand standard specifications along with the various codes of practices required for the design of bridges. This course also aims at enabling the learners to understand the design principles for the design of reinforced concrete slab bridges, prestressed concrete bridges and steel bridges and to design the various components of such bridges.*

Crédits: 04 **L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Definition, Classification and Components of bridges, General features and design considerations for bridges, Introduction to IRC, MORTH, IRS and RDSO codes and guidelines. **Investigation for Bridges:** Selection of bridge site, Preliminary data and drawings, Determination of design discharge, linear waterway, afflux, scour depth and economical span. **Bearings, Joints and Appurtenances:** Definition, importance and classification of bearings, Design of elastomeric pad bearing, Definition and classification of joints, Expansion Joints and their suitability criteria, Definition and classification of appurtenances.	18
II	**Reinforced Concrete Slab Bridges:** Design of kerb - Design of tee beam bridges - Design of panel and cantilever for IRC loading. **Prestressed Concrete Bridges (PCB):** Classification, Design principles for pre-tensioned and post-tensioned PCB, Construction sequence of post-tensioned PCB. **Steel Bridges:** Classification of steel bridges, Design of steel beam culvert and plate girder bridges, Design principles for truss bridges.	22

Text Books:

- Essentials of Bridge Engineering (6th Edition) by D. J Victor, Oxford and IBH Publishing Co. Pvt. Ltd.
- Design of Bridges- N. Krishna Raju (2015).

Reference Books:

- Design of Concrete Bridges – Aswini, Vazirani& Ratwani (2014).
- Bridge Superstructure – N. Rajagopalan (2013)
- IRC, MORTH, IRS and RDSO Codes and guidelines

Focus: This course focuses on employability aligned with CO1 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Classify various components of bridges.
- CO2: Understand the concept of site selection and investigation criteria.
- CO3: Discuss the design considerations based on standard codes and guidelines.
- CO4: Differentiate among various types of bearings, joints and appurtenances.
- CO5: Describe design principles for RC slab bridges, prestressed concrete bridges and steel bridges.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO2
CO2	PO1,PO2/PSO2
CO3	PO1,PO2/PSO2

CO4	PO1,PO2,PO3/PSO2
CO5	PO1,PO3/PSO2

MCEC 0012: CONSTRUCTION MANAGEMENT AND EQUIPMENTS

Objective: *This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high quality concrete for buildings and infrastructure*

Credits: 04 **L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	**Construction Planning:** Introduction, activities involved types of project plan, work breakdown structure. Planning terminologies, Critical path method, forward and backward pass, PERT, Ladder network, Precedence network, Line of balance. **Project scheduling and resource leveling:** Introduction, Resource allocation and leveling for unlimited resources, Resource allocation for limited resources, Multi resource allocation, Optimal scheduling.	20
II	**Excavation and earthmoving equipment:** hoists, cranes, pumps, hauling equipment's, crushers and crushing plants, compressors; Planning and selection; Economics of construction equipment's, procurement and disposal **Concreting equipment:** Piling equipment's; Replacement analysis, economic working life, choosing between alternatives; Maintenance management, equipment maintenance planning; Case examples.	20

Reference Books:

- Gahlot, P.S. and Dhir, B.M. "*Construction Planning and Management*", New Delhi, New Age International (P) Ltd., Publishers,. 2007.
- Chandra, P. *Project- Planning, analysis, selection, financing, implementation and review*. Tata McGraw-Hill, New Delhi. 2007.
- Joy, P. *Handbook of construction management*. Macmillan Indian Limited, New Delhi. 2007.
- BMPTC. BMPTC *Directory of construction equipment and machinery manufactured in India*. BMPTC, New Delhi. 2001.
- Collier A., Ledbetter B. *Engineering cost analysis.* Harper and Row Publishers, New York. 1982.
- Peurifoy, R., Schexnayder, C. *Construction planning, equipment, and methods*. Tata McGraw-Hill, New Delhi. 2002.

Focus: This course focuses on employability aligned with CO3 and CO1

Outcomes:

- CO1: Understand the principles of project management, resource management and inventory.
- CO2: Prepare work break down plan and estimate resources requirements.
- CO3: Solve problems of resource allocation and leveling using network diagrams.
- CO4: Understand basics of procurement for works, goods, and consulting services.
- CO5: Understand about the various plant and equipment's used in construction operations

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 PO7/PSO2
CO2	PO1,PO2, PO7/PSO2
CO3	PO1,PO5,PO7/PSO2
CO4	PO1,PO7/PSO2

CO5	PO1,PO7/PSO2

MCEC 0802: CAD Laboratory –II

Objective: To provide skills for Drafting, modeling, analyzing and designing and develop programing skills using computational tools.

Credits: 01 **L-T-P: 0-0-2**

Module No.	Content	Teaching Hours
I	1. Introduction to MATLAB, use, key features, Matlab window, working with the user interface. 2. Mathematical operation like BODMAS rules, arithmetic, solving arithmetic equations. 3. Mathematical operation of matrix using MATLAB. Like creating rows and columns matrix, transpose, determinant and inverse. 4. Other operations – trigonometric functions, complex numbers, fraction. 5. Plotting of graph (2D & 3D), FFT, Solution of linear equation using MATLAB. 6. Ordinary Differential equations examples. 7. Solve FEM & structural dynamics problems. 8. Analysis of beam using ANSYS. 9. Analysis of truss using ANSYS. 10. Analysis of simple portal frame using ANSYS.	20

Text Books:

1. 1 MATLAB, Technical Reference Manual.
2. Edward Magrab, ShapourAzarm, Engineers Guide to MATLAB, PearsonPublications.
3. Amos Gilat, MATLAB: An Introduction with Applications, WileyPublications.
4. ANSYS, Technical Reference Manual.

Reference Books:

1. Srinivas, Paleti; Finite Element Analysis Using Ansys, PHI Learning.
2. Sham Tickoo, Ansys Workbench 14.0 for Engineers and Designers, Dreamtech Press

Focus: This course focuses on Skill development aligned with CO1

Outcome: After completion of course, the student will be able to:

- CO1: In this lab, students will be able formulate relevant research problems; conduct analytical study and analyzing results with modern mathematical methods and use of software tools.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO3/PSO1

MCEE 0003: NON-CONVENTIONAL CONSTRUCTION MATERIALS & ELEMENTS

Objective: This course provides knowledge on the application and uses of various different types of concrete which results in production and construction of high quality concrete for buildings and infrastructure

Credits: 04 **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	**Ferro cement:** Introduction to Ferro cement design principals, materials used, manufacture of Ferro cement elements, Type of members commonly used, use of Ferro cement in rehabilitation of Structures. **Fiber reinforced concrete:** Various types of fibers like glass, steel, asbestos etc. Physical & Mechanical Properties, Use of Fiber Reinforced Concrete in structural elements.	19
II	**Light weight concrete:** Various types of light weight aggregate, physical and mechanical properties. Introduction to structural plastics and similar elements. Smart materials, Environment friendly materials **Polymers and Polymer Concrete:** Physical and mechanical properties and its use in Civil Engineering. Introduction to Bamboo in Civil Construction, Cementitious composite reinforced with vegetable and hybrid fibers, Construction with Earth	21

Reference Books:

- A. M. Neville, Properties of Concrete, Pearson education (2012).
- Concrete for High Temperature, Maclaren and sons, London- A. Petzold & M.Rohrs (1970).
- Advances in Cement Technology, Tech Book International, New Delhi.- S.N. Ghosh (2006).
- Concrete, Tata Mc Graw Hill.,- P.K.Mehta & Paulo J.M.Monterio(2005)
- **Focus:** This course focuses on employability & Skill development aligned with CO3 and CO4

Focus: This course focuses on employability aligned with CO1

Course Outcomes:

- Understand the application and use of Ferro cement
- Describe the application and use of Fiber reinforced concrete
- Describe the application and use of Light weight concrete
- Understand the application and use of Polymers and Polymer Concrete
- Understand the application and use of Construction with Earth

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs

CO1	PO1 /PSO2
CO2	PO1,PO2/PSO2
CO3	PO1, PO4/PSO2
CO4	PO1,PO3/PSO2
CO5	PO1,PO2/PSO2

MCEE 0004: HIGH RISE STRUCTURES

Objective: The objective of this course is to develop fundamentals of high-rise buildings and their difference with ordinary buildings and develop ability in students to design High Rise Structures

Credits:04 **L-T-P :4-1-0**

Module No.	Content	Teaching Hours
I	Gravity, Wind, Blast & Earthquake Loads. Analysis of Tall Buildings for gravity and lateral loads – Approximate and Exact methods. Sequential and Simultaneous analysis. Load combinations. Design of beams, columns and foundations. Detailing of Joints.	20
II	Plane and coupled shear walls in Tall Buildings. Shear Wall – Frame Interaction, Foundations for Tall Buildings and their design. Analysis and Design of Transmission Towers.	20

Reference Books:

- Response of Multistory Concrete Structures to Lateral Forces, SP–36,ACI Publication(1974)..
- Response of Buildings to Lateral Forces, ACI Task Committee Report 442(1971)..
- Elastic Analysis of Tall Concrete Building, Report of Technical Committee No.21,ACI.
- Tall Building, Programme Press – A.Coull and B.S.Smith(1966),
- Manual on Transmission line Towers, Tech. Report No.9,Central Board of Irrigation and Power(2011)

Focus: This course focuses on employability aligned with CO3 and CO4

Outcomes:

- CO1: Analyze high-rise structures.
- CO2: Design of shear walls
- CO3: Design of tall Buildings
- CO4: Design of Transmission Towers.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2

MCEE 0005: DURABILITY ASSESSMENT AND STRUCTURAL STRENGTHENING OF REINFORCED CONCRETE

Objective: The objective of this course is to develop knowledge about the resistance capacity (durability) of concrete and its reinforcement, its estimate and also how to improve durability.

Credits: 04 **L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	Characterization of concrete making material, Interfacial transition zone and its critical evolution, Pozzolonic material and associated effect on concrete , Transport mechanism such as diffusion permeation, Capillary suction, Adsorption and desorption and migration, Various form of material deterioration in concrete, Effect of sulphates, chlorides and acids on concrete Carbonation and corrosion of reinforcement in concrete. Methods of improving durability of concrete.	20
II	Service life determination and integrated life cycle design of structure. Modeling for durability of concrete. Damage of different type of structure. Assement of damage and repair methodology. Rehabilitation of damaged structure, Method of sealing. Providing additional steel. External Prestressing. Stitching. Jacketing. FRP'S, Rehabilitation techniques , retrofitting method's for concrete structures, Bridge retrofitting with live examples	20

Reference Books:

- Guide to durable Concrete, ACI 201 2R-77. Detroit Michigan: ACI Committee 201(2000).
- Concrete Micro Structure, Properties and Material New Delhi: Tata McGraw Hill- Publishing company limited. - Mehta P.K., & monteiro P.J(2013).
- Durability of Reinforced Concrete in Aggressive Media, Oxford & IBH Publishing Company Pvt. Limited.- Alekseev et al(2003).
- Property of Concrete, Pearson Education Ltd. New Delhi- Neville A.M(2014).
- Integrated Life Cycle Design of Structure.-AskoSarja(2003)

Focus: This course focuses on employability & Skill development aligned with CO3 and CO5

Outcomes:

- Understand the structure and properties of concrete making materials
- Discuss the concrete ingredients and its influence at gaining strength.
- Understand the durability requirements of fresh concrete
- Identify Quality Control tests hardened concrete
- Design concrete mixes as per IRC codes

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO2
CO2	PO1,PO2/PSO2
CO3	PO1,PO2, PO3,PO4/PSO2
CO4	PO1,PO3/PSO2
CO5	PO1,PO2/PSO2

MCEE 0006: EXPERIMENTAL STRESS ANALYSIS

Objective: To study the working principles of different types of strain gauges, understand the model analysis, know the fundamentals of photo elastic coatings study the effects of 2-D photo elasticity, study the working principle of load, pressure and displacement transducers.

Credits: 04 **L-T-P-: 4-0-0**

Module No.	Contents	Teaching Hours
I	**Strain Gauges -** Mechanical and optical strain gauges – Description and operation –Electrical resistance- Inductance and capacitance gauges- Detailed treatment on resistant gauges – Measurement of static and dynamic strains – Strain rosettes – Effect of transverse strains – Use of strain recorders and load cells. **Photo Elasticity**: Stress Analysis by photo elasticity **Two dimensional photo elasticity -** Stress optic law – Introduction to polariscope – Plane and circular polariscope – Compensators and model materials – Material and model fringe value – Calibration of photo elastic materials – Isochromatic and isoclinic fringes –Time edge effects.	18
II	**Three dimensional photo elasticity-** Introduction – Stress freezing techniques – Stress separation techniques – Scattered light photo elasticity – Reflection polariscope. **Model Analysis -** Structural similitude, Use of models, Structural and dimensional analysis, Buckingham Pi Theorem, Muller Breslau's principle for indirect model analysis, Use of Begg's and Eney'sdeformeters – Moment indicators – Design of models for direct and indirect analysis. **Miscellaneous Methods**: Brittle coating method ,Byrefringent coating method, Moire fringe method, Non-destructive testing ,Ultrasonic pulse velocity technique, Rebound hammer method , X-ray method, Gamma-ray method.	22

Reference Books:

1. Rally-Dally: Experimental Stress Analysis McGraw Hill Book Company,New York(1991).
2. P. H. Adam, R. C. Dove: Experimental Stress Analysis and Motion Measurements, Prentice Hall(1964).
3. M. Heteny: Hand book of Experimental Stress Analysis John Wiley and Sons, New York.(1972).
4. Srinath, L.S., (2004), Experimental Stress Analysis, Tata McGraw Hill PublishingCo., New Delhi(1980)..
5. H. I. Langhar: Dimensional Analysis and Theory of Models(1978)
6. Frocht M.M.; Photoelasticity Vol. I &II., John Wiley and Sons, New York.(1998).

Focus: This course focuses on employability aligned with CO1 and CO4

Outcomes: On completion of the course, the students will be able to:

- CO1: Identify the different types of strain gauges carry out model analysis
- CO2: explain the measurement of strain under static and dynamic loads.
- CO3: describe the Mechanical, optical, pneumatic and electrical strain gauges for strain measurement.
- CO4: describe the measurements by using transducers and exciters
- CO5: apply the concepts of photo elastic coatings analyze the behavior of 2-D photo elasticity apply the working principles of transducers

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	POs / PSOs

CO1	PO1/PSO1, PO2/PSO2
CO2	PO1/PSO1, PO2/PSO2, PO3
CO3	PO1/PSO1, PO2/PSO2, PO3
CO4	PO1/PSO1, PO2/PSO2, PO4,
CO5	PO1/PSO1, PO2/PSO2, PO3, PO4, PO5

MCEE 0007: SOFT COMPUTING METHODS FOR CIVIL ENGINEERING

Objective: The objective of this course is to impart various techniques like fuzzy logic, ANN, expert system in generating computer model to solve the complex civil problem dealing with large statistical/experimental data.

Credits: 04 **L-T-P-: 4-0-0**

Module No.	Content	Teaching Hours
I	Expert System: Theory of representation; Working principles of ANN; Two computational paradigms: Multi-layer networks; Auto associative and hetero associative nets; Learning in neural nets: Supervised and unsupervised learning; Application of neural nets; Neural network simulators. Genetic algorithm and Traditional optimization methods; Simple genetic algorithms- reproduction, crossover and mutation; Analysis of GA-operators; Deception.	20
II	Working principles of genetic algorithms; Multi-model and multi-objective optimization; Engineering applications; Introduction with applications for Evolution strategy. Combined use of ANN-GA. Fuzzy sets, fuzzy numbers, fuzzy relations, fuzzy measures, fuzzy logic and the theory of uncertainty and information; applications of the theory to inference and control, clustering, image processing and data handling. Neuro-fuzzy systems, application of Neuro-fuzzy systems; Term Paper: Based on applications and/or algorithms development.	20

Text Books:
1. Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence - Bart, K.(1997)
2. Evolutionary Multiobjective Optimization Algorithms- Deb, K(2011).
3. Genetic Algorithms in Search, Optimization and Machine learning- Goldberg, D. E(1986).

Reference Books:
1. Neural Networks: A Comprehensive Foundations- Haykin, S(1998).
2. Fuzzy Logic with Engineering Applications- Ross, T. J(2004).
3. Introduction to Artificial Neural Systems- Zurada, J.M(2002).

Focus: This course focuses on employability aligned with CO3 and CO5

Outcome: After completion of course, the student will be able to:
- CO1: Understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
- C02 Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
- C03 Learn genetic algoritham and optimizationn methods
- C04 Applications for Evolution strategy. Combined use of ANN-GA.
- C05 Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2
CO5	PO1,PO2 PO3, PO4/PSO1, PSO2

MCEE 0008: OPTIMIZATION METHODS IN CIVIL ENGINEERING

Objective: Introduce methods of optimization to engineering students, including linear programming, network flow algorithms, integer programming, interior point methods, quadratic programming, nonlinear programming, and heuristic methods. Numerous applications are presented in civil, environmental, electrical (control) engineering, and industrial engineering. The goal is to maintain a balance between theory, numerical computation, problem setup for solution by optimization software, and applications to engineering systems.

Credits: 04 **L-T-P-: 4-0-0**

Module No.	Content	Teaching Hours
I	**Introduction**: Engineering application of Optimization, Formulation of design problems as mathematical programming problems, classification of optimization problems. **Optimization Techniques:** Classical optimization, multivariable with no constraints, unconstrained minimization techniques, penalty function techniques, Lagrange multipliers and feasibility techniques. **Linear Programming**: Graphical method, Simplex method, Duality in linear programming (LP), Sensitivity analysis Applications in civil engineering	20
II	**Non-Linear Programming techniques/method**: Unconstrained optimization, one dimensional minimization, golden section, elimination, quadratic and cubic, Fibonacci, interpolation, Direct search, Descent, Constrained optimization, Direct and indirect, Optimization with calculus, Khun-Tucker conditions **Constrained optimization techniques -** Direct, complex, cutting plane, exterior penalty function methods for structural engineering problems.	20

Text Books:

- Optimization Methods for Engineering Design – R.L.Fox(2005).
- Optimization Techniques, Theory and applications – S.S.Rao(2009).
- Introduction to Dynamic Programming – L.Cooper&M.W.Cooper(2014).
- Non-Linear programming: Sequential Unconstrained Minimization Techniques A.V.Fiacco&G.P.McCormic(1988).
- Geometric Programming – Duffin, Peterson & Zenar(1997).

Reference Books:

- Foundation of Optimization – J.D.Wilde&C.L.Beightler(1991).
- An introduction to OR – H Taha(2007).

Focus: This course focuses on employability aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understanding the Concept of optimization and classification of optimization problems
- C02 Formulation simplex methods variable with upper bounds
- C03 Study the Queuing Model, poison and exponential distributions
- C04 Understand the maximization and minimization of convex functions
- C05 To study equality constraints, inequality constraints

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs

CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2
CO5	PO1,PO2 PO3, PO4/PSO1, PSO2

MCEE 0009: SOIL STRUCTURE INTERACTION

Objective: The objective of this course is to provide the students with the basic principles and tools to models soil-foundation structures interaction problems for predicting there, response under external loads etc.

Credits: 04 **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Introduction to soil-foundation interaction problems, idealized soil behavior, foundation behavior, interface behavior, analytical techniques, scope of soil foundation interaction analysis. Idealized soil response models for the analysis of soil-foundation interaction: Elastic models of soil behavior, Winkler model, elastic continuum model, homogeneous and non-homogeneous elastic continuum, isotropic and anisotropic elastic continuum, orthotropic elastic continuum, layered and structured elastic medium. Two parameter elastic models: Filonenko-Borodich model, Paternak model, Hetenyi model, Vlazovmodel,and Reissner model.	20
II	Elastic –plastic and time dependent behavior. Plane-strain analysis of an infinitely long beam and an infinite plate; analysis of beam of finite length under different loading conditions Analysis of circular and rectangular plates on elastic foundations. Settlement analysis of single pile: Load transfer method, analysis based on elastic theory, settlement of pile groups, load deflection prediction for laterally loaded piles, Pile raft system, dynamic loads on piles. Flexural behavior of axially and laterally loaded piles	20

Reference Books:

1. Analytical and Computer Methods in Foundation, McGraw Hill.- Bowels J.E(2014).
2. Elastic Analysis of Soil-Foundation Interaction, Elsevier. -Selvadurai, A. P. S(1979)
3. Pile Foundation Analysis and Design, John Wiley- Poulos H. G. and Davis E. H.(1999)
4. Foundation analysis and design, McGraw Hill.- Bowles J.E(2014).
5. Foundation Analysis, Prentice Hall.- Scott R. F(1996).
6. Numerical Methods in Geotechnical Engineering, McGraw Hill.-Desai C.S.& Christian J.T.(1977)

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

- CO1:To predict the integrated responses of structures to extend the loads, to model interaction phenomenon.
- CO2: Develope basic idea about elastic model helpful about finite element simulation
- CO3: Different types of modeling aproaches give proper idea at the time of modeling
- CO4: Analysis of modeling aproaches of elastic analysis and pile foundation

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO5 /PSO3
CO2	PO1,PO2,PO5 /PSO3
CO3	PO1,PO2,PO3,PO5 /PSO3

CO4	PO1,PO2,PO5 /PSO3

MCEE 0010 THEORY OF PLATES AND SHELLS

Objective: To enable the student analyze and design thin shell structures including domes, hyperbolic, paraboloid, elliptic and cylindrical shells.

Credits:04 **L-T-P-:4-0-0**

Module No.	Content	Teaching Hours
I	Introduction to thin plates, small deflection theory, plate equation.Isotropic and orthotropic plates, bending and twisting of plates,Navier's solution, Levy's solution and energy method, rectangular,circular plates with variable rigidity in Cartesian and polar coordinates, Numerical solutions. Plastic analysis of plates, yeild-linetheory, Introducing to stability of plates.Solution of some typical problems.	24
II	Shells: Introducing to stability of shells, Shell behavior, shell surfaces and characteristics, classification ofshells equilibrium equations in curvilinear co-ordinates. Stress-strain & force displacement relations. Membrane analysis of shellsof revolution. Cylindrical shells under different loads. Shallowshells, membrane solution of elliptic paraboloids and hyperboloids.	16

Reference Books:

- S. Timoshenko, "Theory of Plates and Shells", McGraw-Hill Publishing Company.
- R. Szilard, "Theory & Analysis of Plate - Classical & Numerical Methods" , John
- Wiley & Sons Publishing Company
- Ramaswamy, G. S., "Design & Construction of Concrete Shell Roofs", McGrawHill Publishing Company
- Glibson J. E., "Theory of Cylindrical Shells", North-Holland Publishing Co
- N. K. Bairagi, "Shell Analysis" , Khanna Publishers,

Focus: This course focuses on employability aligned with CO5 and CO4

Outcome: After completion of course, the student will be able to:

- CO1:Understand the concept of concepts of Space Curves, surfaces, shell co-ordinates and boundary conditions.
- CO2:Analyze under axi-symmetric loading, governing differential equation in polar co-ordinates.
- CO3:Understand the membrane theory of cylindrical, conical and spherical shells.
- CO4:Understand the cylindrical and conical shells
- CO5:Application to pipes and pressure vessels, thermal stresses in plate/shell.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2
CO5	PO1,PO2 PO3, PO4/PSO1, PSO2

MCEE 0012: RETROFITTING OF STRUCTURES

Objective: The objective of this course is to develop knowledge about various mechanisms of deterioration of reinforced and plain concrete, its estimate and rehabilitation

Credits: 04 **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Durability of concrete: Factors affecting durability of concrete, Corrosion of reinforcements in concrete, Carbonation, Chloride ingress, Alkali-silica reaction, Freeze-thaw effects, Chemical attack, Abrasion, erosion and cavitation, Weathering and efflorescence Defects and deterioration in buildings, Survey and assessment of structural conditions in RCC structures. Damage/condition assessment and various methods (for quantification) for its evaluation, Rapid Visual Screening (RVS) and ways to do RVS of damaged/deteriorated structures, Overview of health monitoring techniques.	20
II	Non-destructive testing of concrete quality, Non-destructive testing of connections in steel, Corrosion assessment in reinforcements in RCC elements and components in steel structures; Design principles, techniques and working mechanism various instruments used for NDT evaluations (for strength, durability etc.) like Rebound Hammer, UPV, impact echo etc.; Technology used in various advanced instruments like Imaging techniques, GPR, Thermography, Tomography etc. Materials for repairs, rehabilitation and retrofitting processes, Methods for repairs, rehabilitation and retrofitting including surface preparation, Study of failures of buildings and lesson learnt, Role of quality control in construction as Preventive measures Maintenance of buildings.	20

Reference Books:

- Technology of Building Repairs, Raikar R N
- The Bombay Building Repairs & Reconstruction Board Act 1969, Govt. of Maharashtra
- Maintenance & Repairs of Buildings, P. K. Guha
- Concrete Structures Protection Repair and Rehabilitation, R. Dodge Woodson, Elsevier Publication
- Construction, Maintenance & Restoration and Rehabilitation of Highway Bridges, K. S. Rakshit
- Retrofitting of Concrete Structures by Externally Bonded FRP's – CEB – FIP, Technical report,

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Detect defects and deterioration in buildings.
- CO2: Assessment of structural conditions in R.C.C. structures.
- CO3: Understand and apply rehabilitation and retrofitting process and their field applications
- CO4:Analyze non-destructive testing methods and their field applications
- CO5: Interpretation of the results for concrete and steel structures.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs

CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2
CO5	PO1,PO2 PO3, PO4/PSO1, PSO2

MCEE 0013: ADVANCED DESIGN OF METAL STRUCTURES

Objective: The objective of this course is to develop the ability to analyze and design steel structures of advanced level like transmission Towers, Industrial Sheds, etc.

Credits:04 **L-T-P:4-0-0**

Module No.	Content	Teaching Hours
I	Introduction to the use of light gauge steel sections with application to flat slab, grid and orthotropic plates. Design of Aluminum structures. Design of transmission line towers, concept of TV and guyed towers. Buckling of steel columns.	20
II	Beam column and their designs. Rigid, Semi-Rigid and Flexible connections. Plastic methods of Structural Analysis of frames. Design of Industrial trussed bents. Pressed steel construction	20

Reference Books:

- 1. Design of steel structures- Bresler Lin &Scalzi(2000).
- 2. Steel building analysis and design- Crawley &Dhillon(1993).
- 3. Design of steel structures- S. K. Duggal(2010).
- 4. Design of steel structures- Arya&Ajmani(1972).

Focus: This course focuses on employability & Skill development aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1:Design advanced steel structures as per industrial consideration.
- CO1:Analyze and design of Aluminum Structures
- CO2:Developing the understanding of fundamentals of design of Light Gauge Steel.
- CO3:Analyze Structural frames Using Plastic methods.
- CO4:Design of Industrial trussed bents. Pressed steel construction

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4/PSO1, PSO2
CO2	PO1,PO2 PO3, PO4 /PSO1, PSO2
CO3	PO1,PO2 PO3, PO4/PSO1, PSO2
CO4	PO1,PO2 PO3, PO4/PSO1, PSO2

MCEE 0014: DESIGN OF OFFSHORE AND MARINE STRUCTURES

Objective: This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high quality concrete for buildings and infrastructure

Credits: 04 **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Types of offshore structures and conceptual development - Analytical models for jacket structures - Materials and their behaviour under static and dynamic loads - Statutory regulations - Allowable stresses - Various design methods and Code Provisions - Design specification of API, DNV, Lloyd's and other classification societies - Construction of jacket and gravity platforms. Operational loads - Environmental loads due to wind, wave, current and buoyancy - Morison's Equation - Maximum wave force on offshore structure - Concept of Return waves - Principles of Static and dynamic analyses of fixed platforms - Use of approximate methods - Design of structural elements.	20
II	Introduction to tubular joints - Possible modes of failure - Eccentric connections and offset connections - Cylindrical and rectangular structural members – In-plane and multi-plane connections - Parameters of in-plane tubular joints - Kuang's formulae - Elastic stress distribution - Punching shear Stress - Overlapping braces - Stress concentration - Chord collapse and ring stiffener spacing - Stiffened tubes - External hydrostatic pressure - Fatigue of tubular joints - Fatigue behaviour - S-N curves - Palmgren-Miner cumulative damage rule - Design of tubular joints as per API Code. Corrosion - Corrosion mechanism - Types of corrosion - Offshore structure corrosion zones – Biological corrosion - Preventive measures of Corrosion - Principles of cathode protection systems - Sacrificial anode method and impressed current method – Online corrosion monitoring - Corrosion fatigue.	20

Reference Books:

- T. H. Dawson, Offshore Structural Engineering, Prentice Hall
- W. J. Graff, Introduction to Offshore Structures, Gulf Publ. Co.
- B. McClelland, M. D. Reifel, Planning & Design of fixed Offshore Platforms, Van Nostrand
- API RP 2A, Planning, Designing and Constructing Fixed Offshore Platforms, API

Focus: This course focuses on employability aligned with CO1 and CO2

Outcome: After completion of course, the student will be able to:

- CO1: Understand the layout of marine structures from functional and safety requirements.
- CO2: Perform fundamental stability checks of various floating and bottom supported offshore structures.
- CO3: Develop the knowledge and skills to carry out basic tasks regarding structural design
- CO4: Understanding dimensioning of marine structures.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO5 /PSO1
CO2	PO1,P05,PO6 /PSO1
CO3	PO1,P05,PO6 /PSO1
CO4	PO1,PO4,PO5 /PSO1

COURSE STRUCTURE

M.TECH.

TRANSPORTATION ENGINEERING

Under

Choice Based Credit System (CBCS)

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT HRS/WK
			L	T	P		
1	MTEC 0002	Pavement Analysis and Design	4	0	0	4	4
2	MTEC 0003	Highway Soil Mechanics	4	0	0	4	4
3	MTEC 0005	Transportation Economics and Evaluation	4	0	0	4	4
4	MTEC 0006	Advanced Railway Engineering	4	0	0	4	4
5	MTEC 0011	Advanced Traffic Engineering	4	0	0	4	4
6	MTEC 0012	Infrastructure Project Management	4	0	0	4	4
		TOTAL	**24**	**0**	**0**	**24**	**24**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT HRS/WK
			L	T	P		
1	MTEC 0007	Urban Transportation Planning	4	0	0	4	4
2	MTEC 0008	Environmental Impact and Risk Assessment	4	0	0	4	4
3	MTEC 0009	Ground Improvement Techniques	4	0	0	4	4
4	MTEC 0010	Introduction to Remote Sensing and GIS	4	0	0	4	4
5	-	Elective - I	4	0	0	4	4
PRACTICALS							
1	MTEC 0800	Modelling, Analysis and Simulation Lab	0	0	4	2	4
2	MTEC 0802	Application of Remote Sensing & GIS in Transportation Engineering	0	0	4	2	4
		TOTAL	**20**	**0**	**8**	**24**	**28**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT HRS/WK
			L	T	P		
1	-	Elective – II	4	0	0	4	4
2	-	Elective – III	4	0	0	4	4
3	-	Elective – IV	4	0	0	4	4
4	MTEJ 0961	Seminar	0	0	4	2	4
5	MTEJ 0971	Dissertation – I	-	-	-	4	-
		TOTAL	**12**	**0**	**4**	**18**	**16**

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT HRS/WK
			L	T	P		
1	MTEJ 0972	Dissertation - II	-	-	-	14	-
		TOTAL	**0**	**0**	**0**	**14**	**0**

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT HRS/WK
			L	T	P		
1	MTEE 0001	Highway Construction, Quality Control and Maintenance	4	0	0	4	4
2	MTEE 0002	Intelligent Transportation System	4	0	0	4	4
3	MTEE 0003	Airport Planning and Design	4	0	0	4	4
4	MTEE 0004	Advanced Concrete Technology	4	0	0	4	4
5	MTEE 0005	Tunnel Engineering	4	0	0	4	4
6	MTEE 0006	Bridge Engineering	4	0	0	4	4
7	MTEE 0007	Soil Structure Interaction	4	0	0	4	4
8	MTEE 0008	Road Materials and New Innovations in Pavement Engineering	4	0	0	4	4
9	MTEE 0009	Highway Construction Practice	4	0	0	4	4
10	MTEE 0010	Finite Element Method	4	0	0	4	4
11	MTEE 0800	Computer Aided Transportation Engineering Laboratory	0	0	4	2	4
12	MTEE 0801	Pavement Materials Laboratory	0	0	4	2	4

MTEC 0002: PAVEMENT ANALYSIS AND DESIGN

Objective: *To impart knowledge of pavement types and their functions, analysis and design of flexible and Rigid pavement based on recent IRC/AASHTO codes.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Pavements:** History of Pavements, Pavements types, Advantages and Disadvantages **Pavement Mix Analysis:** Aggregate blending, bituminous mix design, Marshall Stability approach, concrete mix design for roads. **Pavement Basics:** Types & comparison, vehicular loading pattern, loading pattern on airport pavement, factors affecting design and performance of pavements, airport pavement, environmental impact on pavements, sub grade requirements.	18
II	**Design of Flexible Pavements:** Analytical approach, flexible pavement layers, ESWL, repetitions of load, techniques of design methods, wheel load analysis, traffic analysis, stress distribution in subgrade soil, Burmister's theories, group index method, CBR approach, IRC guidelines, CRV method, triaxial & McLeod method, present practices, shoulder design. **Design of Concrete Pavements:** Westergaard's approach, temperature & frictional stresses, design of expansion & longitudinal joints, design of dowel & tie bars, IRC guidelines, present design practices.	22

Text Books:

- Yoder and Witezak, *Principles of Pavement Design,* John Wiley and sons
- Yang, *Design of functional pavements,* McGraw, Hill

Reference Books:

- IRC codes : 37, 58, 15 and other relevant codes

Focus: This course focuses on employability aligned with CO3 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Classify the pavement types and their properties.
- CO2: Explain mix design for flexible and rigid pavement.
- CO3: Understand the different loading patterns on different pavements.
- CO4: Design the flexible pavement using CBR method and IRC guidelines
- CO5: Learn about present practices for flexible pavement and shoulder design.
- CO6: Design the Rigid Pavement using Westergaard's approach and IRC guidelines.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2,PO3 /PSO1
CO5	PO1,PO2 /PSO1
CO6	PO1,PO2 /PSO1

MTEC 0003 : HIGHWAY SOIL MECHANICS

Objective: *To impart knowledge of highway soil and Rock Engineering in Pavement construction*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Classification of Soil:** HRB classification. Group Index Method. **Subsoil drainage in Highway**: Design of filters, perforated pipe drainage., Methods of sub soil drainage for roads, permeable blankets, longitudinal and transverse under drains, horizontal drains, stabilizing trenches. Sub soil drainage in runways and railways, Geosynthetic application in highway drainage. **Compaction:** Mechanics of compaction. Field compaction equipment; their suitability and choice. Field Compaction quality control and measurement. **Shear Strength:** Terzaghi's effective stress principle, effective shear parameters, measurement of pore pressures. Stability Analysis of slopes.	20
II	**Earth Pressure Theories:** Coloumb's Wedge Theory, Culman's method. Sheet pile walls and their analysis. **Deep foundations:** Meyorhoff's theory for bearing Capacity. Well foundations, their types, components, well sinking and rectification. Stability analysis. **Rock Engineering:** Fundamental of rock Mechanics; Rock Properties; Rock Mass Classification Systems, Rock load classification according to Terzaghi, RQD index as a qualitative description of the rock mass, limitations and advantages, Geomechanics Classification: General Comments on Application of Rock Mass Classification Schemes.	20

Text Books:

- Rodriguez,A,R, Castillo del.h, *Soil Mechanics in Highway Engineering,* Trans Tech Publications

Reference Books:

- David McCarthy, Essentials of Soil Mechanics and Foundations, Pearson Education
- R. Whitlow, *Basic Soil Mechanics*, Pearson Education

Focus: This course focuses on employability aligned with CO6 and CO4
Outcome: After completion of course, the student will be able to:

- CO1: Soil classification for highway construction
- CO2: Understand proper idea on surface and subsurface system on highway
- CO3: Learn proper idea regarding field compaction
- CO4: Understand proper idea on stability analysis on slope, sheet pile
- CO5: Study Design analysis of retaining structures and deep foundation study
- CO6: Understand basic concepts of Rock mechanics

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO5 / PSO3
CO2	PO1, PO2, PO5, PO12 / PSO3

CO3	PO1, PO2, P05, P012 / PSO3
CO4	PO1, PO2, PO3 / PSO1
CO5	PO1, PO2 / PSO3
CO6	PO1, PO2, P03 / PSO3

MTEC 0005 : TRANSPORTATION ECONOMICS AND EVALUATION

Objective: *To apply the microeconomic concepts of demand, costs, pricing, and project evaluation to analyze transportation activities.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Principles of Economics:** Transportation demand and supply, and models, Interpretation of Elasticities, Factors affecting Elasticities, consumer's surplus, Latent Demand and social surplus criteria, Internal costs and Benefits framework for social accounting: accounting rate of interest, opportunity cost, rate of interest, accounting prices of goods and services.	18
II	**Transport Costs and Benefits:** Fixed and variable cost, cost of improvement, maintenance cost, cost estimating methods, accounting for inflation, external costs, pavement cost analysis, direct benefits, reduced vehicle operation costs, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost. **Economic Analysis:** Generation and screening of project alternatives, different methods of economic analysis: annual cost and benefit ratio methods, discounted cash flow methods, shadow pricing techniques, determination of IRR and NPV, examples of economic analysis, application economic theory in traffic assignment problem.	22

Text Books:

- Highway Economic Analysis, Winfrey R, International Textbook Company
- Transport : An Economics and Management Perspective*, Oxford University Press*

Reference Books:

- Button, K. (2010). Transport economics. Edward Elgar Publishing.

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Learn about supply and demand models in transportation.
- CO2: Explain social accounting framework in Economics
- CO3: Understand the different types of cost related to Transportation Economics.
- CO4: Define the direct benefits in Transportation Economics
- CO5: Learn about screening of project alternatives and Generation.
- CO6: Discuss the application of economic theory in traffic problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO2
CO2	PO1,PO2 /PSO2
CO3	PO1,PO2 /PSO2
CO4	PO1,PO2 /PSO2

CO5	PO1,PO2 /PSO2
CO6	PO1,PO2 /PSO2

MTEC 0006 : ADVANCED RAILWAY ENGINEERING

Objective: *This course provides knowledge of design parameters used for railway track. Also introduces students with inspection, monitoring and construction methods used at site.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Basics & Design Calculations in Indian Railways:** Rail & rail joints (welding of rails, LWR, SWR, CWR), failures in rails, Sleepers, Ballast, Formation and its drainage, track fitting and fastening, Alignment and grades, cross section and its elements (at filling & cutting), grade compensation, cant and cant deficiency, negative cant and widening of gauges on curves, curves used for railway track (horizontal and vertical curves). Elements of A Simple Turn-Out, Details of Switch, Details of Crossings, Number and Angle of Crossings, Geometric Design of Turn-Out.	18
II	**Railway Crossings:** Various type of crossings and their specifications – ROB, Level Crossings, Rail Underpass, etc. **Inspection & Monitoring of Railway Tracks:** Track inspection vehicles, track geometry measurement systems, Ride quality measurements. **Construction & Relaying Techniques:** Telescopic, Trame Line, Mechanical methods of Construction	22

Reference Books:

- Chandra, S. and Agarwal, M.M., Railway Engineering, New Delhi Oxford University Press, (2008).

Text Book:

- Arora, S.P. and Saxena, S.C., Railway Engineering, New Delhi, Dhanpat Rai Publications, (2006).
- Khanna, S.K., Arora, M.G., and Jain, S.S., “Airport Planning and Design”, Roorkee, Nem Chand and Bros, (1994).

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: *After completion of course, the student will be able to:*

- CO1: Know about railway track components, their materials, size, function and importance
- CO2: Carry out geometric design of railway track
- CO3: Know about various components in diverging, merging and crossings of railway tracks, stations, yards, rail underpass.
- CO4: Inspection and monitoring of railway track and riding quality measurement.
- CO5: Construction Techniques for laying railway track.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs

CO1	PO1, PO2, PO3, PO4, PO5, PO6 / PSO1, PSO2
CO2	PO1, PO2, PO3, PO5, PO8, PO9, PO10 / PSO1, PSO2
CO3	PO1, PO2, PO3, PO5, PO9, PO10, PO11 / PSO1, PSO2
CO4	PO1, PO2, PO3, PO6, PO7, PO8, PO9, PO11 / PSO1, PSO2
CO5	PO1, PO2, PO6, PO9, PO10, PO11 / PSO1, PSO2

MTEC 0007 : URBAN TRANSPORTATION PLANNING

Objective: *This course provides a comprehensive knowledge of steps involved in Urban Transportation Planning and Land Use Models.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Transport and Socioeconomic Activities, Historical Development of Transport, Transportation in the Cities, Freight Transportation, Future Developments. **Urban Transportation System Planning, Conceptual Aspects:** Transport Planning Process, Problem Definition, Solution Generation, Solution Analysis, Evaluation and Choice, Implementation, Sequence of Activities Involved in Transport analysis. **Trip Generation Analysis:** Trip Production Analysis, Category Analysis, Trip Attraction Modelling. **Mode Choice Modelling:** Influencing Factors, Earlier Modal Split Models, Trip, End Type Modal Split Model, Trip, Interchange Modal Split Model, Disaggregate Mode, Choice Model, Logit Model of Mode Choice, Binary Choice Situations, Multinomial Logit Model, Model calibration, Case studies.	18
II	**Trip Distribution Analysis:** Presentation of Trip Distribution Data, PA Matrix to OD Matrix, Basis of Trip Distribution, Gravity Model of Trip Distribution, Calibration of Gravity Model, Singly and Doubly Constrained Gravity Models, A case Studies, Growth Factor Methods of Trip Distribution, Uniform Factor Method, Average Factor Method, Fratar Growth Factor Method, Disadvantage of Growth Factor Method. **Route Assignment:** Description of transport network, Route Choice Behavior, The Minimum Path, Minimum Path Algorithm, Route Assignment Techniques, All or Nothing Assignment, Multipath Traffic Assignment, Capacity Restrained Traffic Assignment. **Transport Related Land Use Models:** Development of Land, Use models, The Lowry Model, Application of Lowry Model. **Urban Structure:** Urban Activity Systems, Urban Movement Hierarchies, Types of Urban Structure, Centripetal, Type Urban Structure, Grid Type Urban Structure, Linear, Type Urban Structure, Directional Grid Urban Structure.	22

Text Books:

- Michael D. Meyer, Eric J. Miller, *Urban Transportation Planning,* McGraw Hill

Reference Books:

- C. S. Papacostas and P. D. Prevedouros, *Transportation Engineering and Planning,* Trans Tech Publications
- Hutchinson, B.G. (1974). *Principles of Urban Transport Systems Planning.,* Mc Graw Hill Book Company, New York
- G. E. Gray and L. A. Hoel, *Public Transportation,* New Jersey, (1992)

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Describe needs of transportation in urban areas.
- CO2: Illustrate Urban Transportation system planning and conceptual aspects
- CO3: Classify sequence of activities involved in transportation planning and analysis.
- CO4: Develop four stage modelling for Traffic demand.
- CO5: Assess urban transportation issues.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 / PSO1, PSO2
CO1	PO1, PO2, PO3 / PSO1, PSO2
CO1	PO1, PO2, PO3, PO4, PO5 / PSO1, PSO2
CO1	PO1, PO2, PO3, PO4, PO5, PO10 / PSO1, PSO2
CO1	PO1, PO2, PO3, PO4, PO10, PO11 / PSO1, PSO2

MTEC 0008: ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

Objective: *Objective of this course is to identify, predict and evaluate the economic, environmental and social impact of development activities*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Environmental impact assessment (EIA):** definitions and concepts, Evolution of EIA, Initial environmental examination, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, Post project monitoring, EIA report and environmental impact statement (EIS); Post project monitoring, Review process. Status of EIA in India; Case studies on project, regional and sectoral EIA	20
II	**Environment Risk Assessment:** Introduction, Objectives, Risk assessment methodology, Pre and post mitigation risk assessment.	20

Text Books:

- Canter, L. W., Environmental Impact Assessment, McGraw-Hill, 2 nd Ed., 1997.

Reference Books:

- Agarwal, N. P., Environmental Reporting and Auditing, Raj Pub., 2002.
- J. G. Rau and D. C. Wooten, Environmental Impact Analysis Handbook, McGraw-Hill, 1980.
- C. H. Eccleston, Environment Impact Statements: A Comprehensive Guide to Project and Strategic Planning, John Wiley & Sons, 2000.

Focus: This course focuses on employability aligned with CO3 and CO1

Outcome: After completion of course, the student will be able to:

- CO1: Understand the concept of environmental impact assessment and its evolution
- CO2: Evaluate the impact of development activities on environment.
- CO3: Analyze the environment risk and its assessment
- CO4: Understand the pre and post mitigation risk assessment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO4,PO9 /PSO2
CO2	PO1,PO2, PO3 /PSO2
CO3	PO1, PO2,PO3, PO9 /PSO2

CO4	PO1,PO7 /PSO2

MTEC 0009 : GROUND IMPROVEMENT TECHNIQUES

Objective: *This course provides a comprehensive knowledge of soil stabilization using mechanical methods, admixtures and grouting. This course also introduces students with slope stabilization methods with some discussion of case studies.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction :** Need for Ground Improvement, Different types of problematic soils, Emerging trends in ground Improvement. **Mechanical stabilization :** Shallow and deep compaction requirements, Principles and methods of soil compaction, Shallow compaction and methods. Properties of compacted soil and compaction control, Deep compaction and Vibratory methods Dynamic compaction.	18
II	**In situ ground improvement methods:** Ground Improvement by drainage, Dewatering methods. Design of dewatering systems, Preloading, Vertical drains, vacuum consolidation, Electro-kinetic dewatering, Design and construction of Stone column. **Modification by admixtures:** Cement stabilization and cement columns, Lime stabilization and lime columns. Stabilization using bitumen and emulsions, Stabilization using industrial wastes Construction techniques and applications. **Grouting :** Permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions. **Slope stabilization methods :** Soil nailing, rock anchoring, micro- piles, design methods, construction techniques. **Case studies:** Case studies of ground improvement projects.	22

Text Books:

- Manfired R. Hausmann, Engineering Principles of Ground Modification, McGraw-Hill Pub, Co.

Reference Books:

- Bowels, J. E, Foundation Analysis and Design, McGraw-Hill International Edition Singapore, 1997
- Moseley, M. P, Ground Improvement, Blackie Academic & Professional, BocaRaton, Florida, USA, 1993
- Teng, W. C, Foundation Design, Prentice Hall of India Pvt. Ltd

Focus: This course focuses on employability aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the need of Ground Modification/Improvement
- CO2: Learn the mechanical/physical modes of ground improvement
- CO3: Understand the effectiveness of drainage on soil densification
- CO4: Learn the chemical modes of ground improvement: admixtures
- CO5: Learn the insitu techniques of Ground Improvement.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO6, PO11 / PSO2
CO2	PO1, PO2, PO3, PO9, PO10 / PSO1, PSO2
CO3	PO1, PO2, PO9, PO10 / PSO1, PSO2
CO4	PO1, PO2, PO3, PO9, PO10, PO11 / PSO1, PSO2
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11 / PSO1, PSO2

MTEC 0010 : INTRODUCTION TO REMOTE SENSING AND GIS

Objective: *This course introduces students with basics of remote sensing, GIS and also theoretical knowledge to develop a transportation GIS model.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Remote Sensing :** Physics of remote sensing, Ideal remote sensing system, Remote sensing satellites and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multiconcept, FCC, Interpretation of remote sensing images. **Digital Image Processing :** Satellite image, characteristics and formats, Image histogram, Introduction to image rectification, Image enhancement, Land use and land cover classification system.	18
II	**Geographic Information System (GIS) :** Basic concept of geographic data, GIS and its components, Data acquisition, Raster and vector formats, Topography and data models, Spatial modeling, Data output, GIS applications. **Global Positioning System (GPS) :** Introduction, Satellite navigation system, GPS, space segment, Control segment, User segment, GPS satellite signals, Receivers; Static, Kinematic and Differential GPS. **Applications in Transportation Engineering :** Intelligent Transport System, Urban Transport Planning, Accident Studies, Transport System Management, Road Network Planning, Collecting Road Inventory.	22

Text Books:

- C.S. Agrawal& P K Garg, *Text Book on Remote Sensing*, Wheeler First

Reference Books:

- C.P LO Albert KW Yeung, Concepts and techniques of Geographic Information Systems, Printice Hall of India, 2002.
- Paul A. Longley, M. Goodchild, David Maguire, David Rhind, Geographic Information Systems and Science, Wiley, First.
- Keith C. Clerk, BradelyO Parks, Michel P Crane, Geographic Informaiton System and Enviornment Modeling, Printicece Hall of India, 2002.
- John R Jensen, Remote Sensing of the Environment ..an Earth Resource Perspective, Pearson Education, 2006.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Describe remote sensing and GIS.
- CO2: Illustrate digital image processing methods.
- CO3: Interpret satellite images.
- CO4: Application of remote sensing and GIS in transportation engineering.
- CO5: Generate GIS model.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO6 / PSO1, PSO2
CO2	PO1, PO2, PO3, PO5, PO8, PO9, PO10 / PSO1, PSO2
CO3	PO1, PO2, PO3, PO5, PO9, PO10, PO11 / PSO1, PSO2
CO4	PO1, PO2, PO3, PO6, PO7, PO8, PO9, PO11 / PSO1, PSO2
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11 / PSO1, PSO2

MTEC 0011 : ADVANCED TRAFFIC ENGINEERING

Objective: *This course provides a comprehensive knowledge of Traffic Engineering including traffic survey, traffic analysis and design.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Traffic Engineering & Studies:** Scope, traffic elements, characteristics, vehicle, road user and road; traffic studies, volume, O & D, parking, safety, study methodology, data collection & presentation. **Traffic Analysis:** Speed, volume, parking & accident data analysis, statistical approach, conflict points, traffic stream characteristics, relationship between speed, flow and density, LOS & capacity analysis, traffic	18
II	**Traffic Design:** Channelization of islands, design of rotaries, intersections, pedestrian & bicycle ways, **Traffic Control Devices:** Traffic signs, markings and signals; **Traffic Regulation & Management:** Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, management various techniques Geometric design provisions for various transportation facilities as per AASHTO, IRC design.	22

Text Books:

- Garber N. J., Hoel L. A., Traffic and Highway Engineering, Wadsworth Publishing Co Inc.

Reference Books:

- Pignataro L. J., Traffic Engineering, Theory & Practice, John Wiley Publishing House
- O'Flaherty, Edward Arnold, Highways, Traffic Planning & Engineering, UK
- Kadiyali L.R., Traffic Engineering and Transport Planning, Khhanna Publishers
- Relevant IS and IRC codes
- **Focus:** This course focuses on employability aligned with CO3 and CO4

Focus: This course focuses on employability aligned with CO3 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Perform basic statistical analysis of traffic data
- CO2: Use speed-flow relationships and conduct shockwave analysis
- CO3: Analyze capacity of different kinds of roads and intersections
- CO4: Design traffic signal timing
- CO5: Recommend suitable traffic management and demand management measures

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO6 / PSO1, PSO2

CO2	PO1, PO2, PO3, PO5, PO8, PO9, PO10 / PSO1, PSO2
CO3	PO1, PO2, PO3, PO5, PO9, PO10, PO11 / PSO1, PSO2
CO4	PO1, PO2, PO3, PO6, PO7, PO8, PO9, PO11 / PSO1, PSO2
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11 / PSO1, PSO2

MTEC 0012 : INFRASTRUCTURE PROJECT MANAGEMENT

Objective: *The objective of this course is to enable the learners to understand the basics of project management, project planning and time management. This course also aims at developing an understanding of organizing the projects, planning for resource management and estimating costs for infrastructure projects.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction, Project Management process, Project Management techniques, Relationship to other management disciplines, Related endeavors, Concentric project management, Project formulation and development. **Project Planning and Time Management:** Purpose, Project scheduling, activity definition, activity sequencing, activity duration estimating, schedule development, schedule control, project management using CPM\PERT- Network basics, Network development, PERT analysis, advantages. Computerized network analysis- features of PM software, capabilities of PM software, Multi project analysis.	18
II	**Organizing for Project Management:** Project Management, modern trends, Strategic Planning, Effects of Project Risks on Organization, Organization of Project Participants, Traditional Designer Constructor Sequence, Professional Construction Management, owner builder Operation, and Turnkey Operation. **Resource Planning:** Introduction, Inputs, Tools, Outputs, Resource scheduling, Resource leveling, Resource restrained scheduling, strategies for shortening the schedule Assigning resources: Work, duration, resources, Effort driven scheduling, create a resource list, Exercise on resource planning using software, Level now command, leveling Gantt chart. **Cost Estimation:** Costs Associated with Constructed Facilities, Approaches to Cost Estimation, Type of Construction Cost Estimates, Effects of Scale on Construction Cost, Unit Cost Method of Estimation, Methods for Allocation of Joint Costs.	22

Text Books:

- Harold Kerzner – Project Management – systems approach to planning, scheduling & controlling – 7th edition, John wiley & sons, Canada.
- Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 1998

Reference Books:

- Choudhury S. "Project Management", McGraw-Hill Publishing Company, New Delhi, 1988.
- Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders", Prentice Hall, Pittsburgh, 2000

Focus: This course focuses on employability aligned with CO3 and CO2

Outcome: After completion of course, the student will be able to:

- CO1: Understand the processes and techniques for project management and project formulation.
- CO2: Describe project planning and time management techniques.
- CO3: Analyse time components in projects through Gantt charts, CPM and PERT network techniques.

- CO4: Optimize resources of projects using scheduling, fast tracking and re-estimation techniques.
- CO5: Explain different approaches for estimating cost.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO7/PSO1
CO2	PO5,PO7/PSO1
CO3	PO2,PO5,PO7/PSO2
CO4	PO1,PO2,PO7/PSO1
CO5	PO1,PO2/PSO2

MTEC 0802 : APPLICATION OF REMOTE SENSING & GIS IN TRANSPORTATION ENGINEERING

Objective: *This course introduces students with practical knowledge of remote sensing, GIS and also to develop transportation GIS model.*

Credits: 02 **L-T-P-J: 0-0-0-4**

Module No.	Contents	Teaching Hours
I	• Spatial Digital Data and its Formats • Digital Image analysis (rectification, enhancement, FCC) • Image Classification • Vector Data generation, topology building and attribution • Generation of Contour, DEM, TIN • Overlay, Buffer and Network analysis • Models for Resource analysis.	40

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic components of GIS
- CO2: Perform various image processing tools on GIS Software.
- CO3: Perform different methods of Image classification and Contour, DEM, TIN on satellite images.
- CO4: Perform Overlay, Buffer and Network analysis considering transportation systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO6 / PSO1, PSO2
CO2	PO1, PO2, PO3, PO5, PO8, PO9, PO10 / PSO1, PSO2
CO3	PO1, PO2, PO3, PO5, PO9, PO10, PO11 / PSO1, PSO2
CO4	PO1, PO2, PO3, PO6, PO7, PO8, PO9, PO11 / PSO1, PSO2

MTEE 0001 : HIGHWAY CONSTRUCTION, QUALITY CONTROL AND MAINTENANCE

Objective: *Learn and define the various component of pavement structure, Organization structure, maintenance of roads and Quality Assurance Plan.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Highway Construction :** Types of Highway Construction, Earthwork specifications, Equipment, Types and Construction of Bituminous Pavements, Guidelines for construction of Cement Concrete Pavement **Management of Quality:** Organisation for Quality Assurance, Duties and Responsibilities, Methods Statement, Working Drawings, Review, Revision and Recording of Drawings, Site Inspections, Daily Reports and Diaries, Daily Inspection Reports, Field Inspection Diaries	18
II	**Quality Assurance Plan:** Quality Control, Types of Quality Control, Performance of Quality Control, Testing Facilities, Test Specification and frequencies, Method Control, Quality Parameters, Reporting of Test Results, Interpretation Test Results **Scope of Operation & Maintenance:** Requirements, Organisation Structure & Key Personnel, Ordinary Repairs, Periodic Renewal, Special Repairs, Flood Damages and Emergency Repairs, Inspection	22

Text Books:

- National Highways Authority of India, Manual Of Specifications & Standards, (2006)
- National Highways Authority of India, Nhai Works Manual, (2006)
- National Highways Authority of India, Quality Assurance Manual, (2006)
- National Highways Authority of India, Quality Audit Manual (Qam) Volume - I, (2001)
- National Highways Authority of India, Operations & Maintenance Manual, (2015)

Reference Books:

- Khanna, S. K. and Justo C. E. G., Highway Engineering, Roorkee, Nemchand Bros. (2001).

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Learn about Highway construction and Earthwork specifications.
- CO2: Explain guidelines of construction process for concrete pavement and Bituminous pavement.
- CO3: Discuss the management of quality in Road project.
- CO4: Discuss the quality assurance plan for pavements.
- CO5: Explain the scope of operation and maintenance of pavements.
- CO6: Understand the organization structure.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO2

CO2	PO1, PO2 /PSO2
CO3	PO1, PO2 /PSO2
CO4	PO1, PO2 /PSO2
CO5	PO1, PO2 /PSO2
CO6	PO1, PO2 / PSO2

MTEE 0002 : INTELLIGENT TRANSPORTATION SYSTEM

Objective: *This course provides a comprehensive knowledge of Traffic Engineering including traffic survey, traffic analysis and design.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Intelligent Transportation Systems (ITS) :** Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS, ITS Data collection techniques, Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection. **Telecommunications in ITS :** Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle, Road side communication, Vehicle Positioning System	18
II	**ITS functional areas :** Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS). **ITS User Needs and Services :** Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management. Automated Highway Systems : Vehicles in Platoons, Integration of Automated Highway Systems. ITS Programs in the World, Overview of ITS implementations in developed countries, ITS in developing countries.	22

Text Books:

- Sussman, J. M., *Perspective on ITS*, Artech House Publishers, 2005.

Reference Books:

- ITS Hand Book 2000: *Recommendations for World Road Association (PIARC)* by Kan Paul Chen, John Miles.
- National ITS Architecture Documentation, US Department of Transportation, 2007.

Focus: This course focuses on employability aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Introduction to Intelligent Transportation System(ITS)
- CO2: Explain telecommunication in ITS
- CO3: Discuss functional areas of ITS.
- CO4: Determine the user needs and services
- CO5: Overview of ITS implementation in developing and developed countries.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO6 / PSO1, PSO2
CO2	PO1, PO2, PO3, PO5, PO8, PO9, PO10 / PSO1, PSO2
CO3	PO1, PO2, PO3, PO5, PO9, PO10, PO11 / PSO1, PSO2
CO4	PO1, PO2, PO3, PO6, PO7, PO8, PO9, PO11 / PSO1, PSO2
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11 / PSO1, PSO2

MTEE 0003 : AIRPORT PLANNING AND DESIGN

Objective: *This course provides a knowledge of airport planning and design parameters used for geometric design of runway.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Aircraft characteristics:** Aircraft characteristics related to airport design; Airport configuration – Runway configurations, Relation of terminal area to runways, Runway orientation, Wind rose diagram. **Geometric design of the airfield:** ICAO and FAA design standards, Runways, Taxiways, Holding aprons and aprons	18
II	**Planning and design of the terminal area:** Apron-gate system, Size and number of gates, Aircraft parking configurations, Passenger terminal system. **Design of Runway & Taxiways** **Airport lighting and marking** **Air traffic control;** Airport planning and air travel demand forecasting	22

Text Books:

- Khanna and Arora, Airport Planning and Design, New Delhi, Dhanpat Rai & Sons (2015).

Reference Books:

- Rao, G.V, Airport Planning and Design, Tata McGraw Hill, (1992)
- Saxena S. C., Airport Engineering (Planning and Design), New Delhi CBS Publications & Distributors (2015).

Focus: This course focuses on employability aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Discuss aircraft characteristics related to airport design and various configuration of runway.
- CO2: Learn geometric design of airfield confirming to ICAO and FAA parameters.
- CO3: Explain planning and design of terminal area.
- CO4: Understand runway markings and lighting standards.
- CO5: Design of runway pavement based on travel demand forecasting.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO6 / PSO1, PSO2
CO2	PO1, PO2, PO3, PO5, PO8, PO9, PO10 / PSO1, PSO2

CO3	PO1, PO2, PO3, PO5, PO9, PO10, PO11 / PSO1, PSO2
CO4	PO1, PO2, PO3, PO6, PO7, PO8, PO9, PO11 / PSO1, PSO2
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11 / PSO1, PSO2

MTEE 0004 : ADVANCED CONCRETE TECHNOLOGY

Objective: *This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high quality concrete for buildings and Infrastructure.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Cement production, composition and cement chemistry:** Importance of Bogue's compounds, Structure of a Hydrated Cement Paste, Volume of hydrated product, porosity of paste and concrete, transition Zone, Elastic Modulus, factors affecting strength and elasticity of concrete **Aggregates for concrete:** Review of types and classification; chemical composition; origin and manufacture; actions and interactions; usage; effects on properties of concretes **Chemical admixtures**: Mechanism of chemical admixture, Plasticizers and super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh cone test for optimum dosage of super plasticizer, retarder, accelerator, Air-entraining admixtures, new generation superplasticizer. **Mineral admixtures:** Fly ash, Silica fume, GCBS, and their effect on concrete property in fresh state and hardened state.	20
II	**Fresh concrete:** Rheology of concentrated suspensions, pastes, mortars and concretes; workability, segregation and bleeding. Theory and principles governing the correct placing and compaction of concrete. **Properties of hardened concrete:** Plastic settlement and plastic shrinkage; exothermic characteristics; early age thermal movements; strength development; maturity, accelerated curing Strength; deformation under load; elasticity; creep; drying shrinkage and other volume changes. Thermal properties. **Durability of concrete:** Durability concept; pore structure and transport processes; reinforcement corrosion; fire resistance; frost damage; sulfate attack; alkali silica reaction; delayed Ettringite formation; methods of providing durable concrete; short-term tests to assess long-term behaviour.	20

Reference Books:

- M. Neville, Properties of Concrete, Pearson education (2012).
- Performance Criteria for Concrete Durability, E & F N Spon, London.- J. Kroop and H.K.Hilsdorf(2004).
- Concrete Construction Engineering Hand Book, CRC Press, New York.- Edward G Nawy (2008).
- Concrete Technology, theory and Practice, S.Chand- M. S. Shetty(2000)
- Concrete Technology, Theory and Practice, McGraw Hill.- M. L. Gambhir(2013)
- Concrete, Tata Mc Graw Hill.,- P.K.Mehta & Paulo J.M.Monterio (2005)
- Advances in Cement Technology, Tech Book International, New Delhi.-S.N.Ghosh (2006).

Focus: This course focuses on employability aligned with CO2 and CO1

Course Outcomes:

- CO1: Understand the structure and properties of concrete making materials
- CO2: Discuss the concrete ingredients and its influence at gaining strength.
- CO3: Understand the durability requirements of fresh concrete
- CO4: Identify Quality Control tests hardened concrete

- CO5: Design concrete mixes as per IS codes

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO2
CO2	PO1,PO2/PSO2
CO3	PO1,PO2, PO4/PSO2
CO4	PO1,PO3/PSO2
CO5	PO1,PO2/PSO2

MTEE 0005 : TUNNEL ENGINEERING

Objective: *To impart knowledge of design and construction of tunneling.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Types and purpose of tunnels of tunneling and application, parameters influencing location of tunnel, shape and size; geological aspects; planning and site investigations, Problem and hazard in tunneling, drainage ventilation in tunnels. **Tunneling Techniques:** factors affecting choice of excavation technique; Methods - soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; jacked box excavation techniques, muck disposal, problems encountered and remedial measures.	20
II	**Drilling and blasting:** Principles, drilling equipment, drilling tools, drill selection, specific drilling, rock drilling factors; Blasting - explosives, initiators, blasting mechanics, blast holes nomenclature; blast design, tunnel blast performance - powder factor. **NATM**: principles and applications of NATM **Tunnel Boring Machines:** Principles, method of excavation, selection, performance, limitations and problems; TBM applications. Ground Treatment in Tunneling: Adverse ground conditions effect on tunneling; Methods of ground control.	20

Text Books:

- D.R.Brox, Practical Guide to Rock Tunneling, Taylor and Francis Group
- Bernhard Maidl and Markus Thewes, Ulrich Maidl, Handbook of Tunnel Engineering II: Basics and *Additional Services for Design and Construction*, Wiley Ernst & sons.

Reference Books:

- A. T. Spathis, R.N. Gupta, *Tunneling in Rock by Drilling and Blasting,* CRC Press, Taylor and Francis Group

Focus: This course focuses on employability aligned with CO3 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Understand type and importance of tunnel engineering
- CO2: Study tunnel engineering techniques
- CO3: Design and study of drilling and blasting
- CO4: Understand the technology of Tunnel boring machine
- CO5: Analyze the Ground treatment of tunneling

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO3 / PSO1, PSO2
CO2	PO1,PO2,PO5 / PSO1, PSO2
CO3	PO1,PO2,PO5 / PSO1, PSO2

CO4	PO1,PO2,PO3 / PSO1, PSO2
CO5	PO1,PO2 / PSO1, PSO2

MTEE 0006: BRIDGE ENGINEERING

Objective: *The objective of this course is to introduce the learner with the basic concepts of bridge engineering and to enable him/her to understand standard specifications along with the various codes of practices required for the design of bridges. This course also aims at enabling the learners to understand the design principles for the design of concrete, steel and composite bridges and to design the various components of such bridges.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Components of bridges, Classification of bridges with general features, Introduction to standard specifications and codes of practices such as IRC, MORTH, IRS and RDSO. **Investigation for Bridges:** Selection of bridge site, Preliminary data and drawings, Determination of design discharge, linear waterway, afflux, scour depth and economical span. **General Design Considerations:** Design considerations for concrete, steel and composite bridges. Standards for road and railway bridges.	18
II	**Bridge Design:** Introduction to Courbon's method, Guyon Massonnet method and Hendry Jaeger method, Design of T-beam and Slab bridge deck and steel truss bridges. **Bearings, Joints and Appurtenances:** Definition, importance and classification of bearings, Design of Elastomeric Pad Bearing, Definition and classification of joints, Expansion Joints and their suitability criteria, Definition and classification of Appurtenances. **Construction and Maintenance of Bridges:** Introduction to various methods of construction of continuous concrete bridges such as Cast in place construction on staging, Segmental cantilever method, span by span method and incremental launching method, Numbering of bridges, Bridge management system, Inspection and maintenance of bridges.	22

Text Books:

- Essentials of Bridge Engineering (6th Edition) by D. J Victor, Oxford & IBH Publishing Co. Pvt. Ltd.
- Design of Bridges- N. Krishna Raju (2015).

Reference Books:

- Design of Concrete Bridges – Aswini, Vazirani & Ratwani (2014).
- Bridge Superstructure – N. Rajagopalan (2013)
- IRC, MORTH, IRS and RDSO Codes and guidelines

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Classify the bridges and their components
- CO2: Understand the concept of site selection and investigation criteria.
- CO3: Discuss the design considerations based on standard codes and guidelines.
- CO4: Explain various methods for estimation of the load distribution among longitudinal girders.

- CO5: Differentiate among various types of bearings, joints and appurtenances.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1/ PSO1
CO2	PO1,PO2/ PSO1
CO3	PO1,PO2,PO11/ PSO1
CO4	PO1,PO2 / PSO1
CO5	PO1,PO2/ PSO2

MTEE 0007 : SOIL STRUCTURE INTERACTION

Objective: *The objective of this course is to provide the students with the basic principles and tools to models soil-foundation structures interaction problems for predicting there, response under external loads etc.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	Introduction to soil-foundation interaction problems, idealized soil behavior, foundation behavior, interface behavior, analytical techniques, scope of soil foundation interaction analysis. Idealized soil response models for the analysis of soil-foundation interaction: Elastic models of soil behavior, Winkler model, elastic continuum model, homogeneous and non-homogeneous elastic continuum, isotropic and anisotropic elastic continuum, orthotropic elastic continuum, layered and structured elastic medium. Two parameter elastic models: Filonenko-Borodich model, Paternak model, Hetenyi model, Vlazovmodel,andReissner model.	20
II	Elastic –plastic and time dependent behavior. Plane-strain analysis of an infinitely long beam and an infinite plate; analysis of beam of finite length under different loading conditions Analysis of circular and rectangular plates on elastic foundations. Settlement analysis of single pile: Load transfer method, analysis based on elastic theory, settlement of pile groups, load deflection prediction for laterally loaded piles, Pile raft system, dynamic loads on piles. Flexural behavior of axially and laterally loaded piles	20

Text Books:

1. Pile Foundation Analysis and Design, John Wiley- Poulos H. G. and Davis E. H.(1999)
2. Foundation analysis and design, McGraw Hill.- Bowles J.E(2014).
3. Foundation Analysis, Prentice Hall.- Scott R. F(1996).

Reference Books:

4. Analytical and Computer Methods in Foundation, McGraw Hill.- Bowels J.E(2014).
5. Elastic Analysis of Soil-Foundation Interaction, Elsevier. -Selvadurai, A. P. S(1979)
6. Numerical Methods in Geotechnical Engineering, McGraw Hill.-Desai C.S.& Christian J.T.(1977)

Focus: This course focuses on employability aligned with CO1 and CO2

Outcome: After completion of course, the student will be able to:

- CO1: To predict the integrated responses of structures to extend the loads, to model interaction phenomenon.
- CO2: Develope basic idea about elastic model helpful about finite element simulation
- CO3: Different types of modeling aproaches give proper idea at the time of modeling
- CO4: Analysis of modeling aproaches of elastic analysis and pile foundation

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO5 /PSO3

CO2	PO1,PO2,P05 /PSO3
CO3	PO1,PO2,P03,P05 /PSO3
CO4	PO1,PO2,PO5 /PSO3

MTEE 0008: ROAD MATERIALS AND NEW INNOVATIONS IN PAVEMENT ENGINEERING

Objective: *To learn about different types of road materials for both rigid and flexible pavement, also about uses of composite materials, recycled waste product in pavement layers.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Aggregate:** Nature and properties, aggregate requirements, types and processing, aggregates for pavement base, aggregate for bituminous mixture, aggregate for Portland Cement Concrete, light weight aggregate, tests on aggregate, specification. **Bituminous Materials:** conventional and modified binders, production, types and grade, physical and chemical properties and uses, types of asphalt pavement construction, principles of bituminous	18
II	**Cement /concrete based materials:** Cement, properties, PCC mix design and properties, modified PCC, Mix Design, Behaviour, Performance, Tests on Cement and Concrete mixes. High Performance Concrete, low shrinkage, increased strength. **Composites, Plastics and Geosynthetics:** Plastics and polymerization process, properties, durability and chemical composition, Reinforced Polymer Composites, Geosynthetics, Dry Powdered Polymers, Enzymes.	22

Text Books:

- P. T. Sherwood, *Alternative Materials in Road Construction*, Thomas Telford Publication, London, 1997.
- RRL, DSIR, *Soil Mechanics for Road Engineers,* HMSO, London, 1995

Reference Books:

- Koerner, R. M. *Designing with Geosynthetics,* Prentice Hall, Englewood Cliffs, New Jersey, U.S.A.
- Shan Somayaji, *Civil Engineering Materials*, second edition, Prentice Hall Inc., 2001.

Focus: This course focuses on employability aligned with CO6 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Define the aggregate properties and requirement.
- CO2: Discuss about conventional and modified binders, their types and grades.
- CO3: Learn bituminous mix design principles.
- CO4: Classify the different materials used in Concrete pavement.
- CO5: Discuss about plastics, composites, Geosynthetics uses in pavement.
- CO6: Learn about recycling of waste from pavements.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO2
CO2	PO1,PO2 /PSO2
CO3	PO1,PO2 /PSO2
CO4	PO1,PO2,/PSO2
CO5	PO1,PO2 /PSO2
CO6	PO1,PO2 /PSO2

MTEE 0009: HIGHWAY CONSTRUCTION PRACTICE

Objective: To learn about Concrete Road construction, hill road construction, preparation of embankment according to Guidelines given by MORT&H and AASHTO

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Embankment Construction:** Formation cutting in Soil and hard rock, Preparation of Subgrade, Ground improvement, Retaining and Breast walls on hill roads, Granular and Stabilized Sub bases / bases, Water Bound Macadam (WBM), Wet Mix Macadam (WMM), Cement treated bases, Dry Lean Concrete (DLC). **Bituminous Constructions:** Types of Bituminous Constructions, Interface Treatments, Bituminous Surfacing and wearing Courses for roads and bridge deck slabs, Selection of wearing Course under different Climatic and Traffic conditions, IRC specifications, Construction techniques and Quality Control.	20
II	**Concrete road construction:** Test on Concrete mixes, Construction equipments, Method of construction of joints in concrete pavements, Quality Control in Construction of Concrete pavements, Construction of Continuously reinforced, Prestressed, Steel Fibre Reinforced (SFRC) Pavements, IRC, MORT&H, ACI Specifications, AASHTO Specifications, Recycled pavements, Non, Conventional Pavements, Overlay Construction. **Hill Roads Construction:** Stability of Slopes, Landslides, Causes and Control measures, Construction of Bituminous and Cement Concrete roads at high altitudes, Hill road drainage, Construction and maintenance problems and remedial measures.	20

Text Books:

- Guideline of MORT&H
- Guidelines of AASHTO

Reference Books:

- Latest IRC Codes

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Explain the process of embankment construction for pavement.
- CO2: Discuss the types of Bituminous constructions and treatments given.
- CO3: Understand the IRC specifications and quality control for construction.
- CO4: Explain the methods of construction of joints in concrete pavement.
- CO5: Describe the specifications by AASHTO, ACI, IRC, MORTH
- CO6: Discuss the construction of hill roads, stability and control measures.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs

CO1	PO1,PO2 /PSO2
CO2	PO1,PO2 /PSO2
CO3	PO1,PO2 /PSO2
CO4	PO1,PO2,/PSO2
CO5	PO1,PO2 /PSO2
CO6	PO1,PO2 /PSO2

MTEE 0010 : Finite Element Method

Objective: *1. To provide the fundamental concepts of the theory of the finite element method.*
2. To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general – purpose finite element code.

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Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Finite Element Analysis:** Introduction Basic Concepts of Finite Element Analysis Introduction to Elasticity Steps in Finite Element Analysis **Finite Element Formulation Techniques**: Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions **Element Properties:** Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Iso parametric Formulation, Stiffness Matrix of Iso parametric Elements, Numerical Integration: One Dimensional. Numerical Integration: Two and Three Dimensional	20
II	**Analysis of Frame Structures:** Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame **FEM for Two and Three Dimensional Solids:** Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axi symmetric Element, Finite Element Formulation of Axi symmetric Element, Finite Element Formulation for 3 Dimensional Elements	20

Reference Books/ Text Book / Cases:

- Finite Element Method for Engineers and scientists – O.C.Zienkiewicz (2013).
- Numerical Methods in Finite Element Analysis – K.J.Bathe & E.L.Wilson (2014).
- Matrix Computations for Engineers & scientists – Alan Jennings(1977).
- Introduction to Finite Element Method – C.S.Desai & J.F.Abel (2001).
- Finite Element Method in Engineering – S.S. Rao (2011)

Focus: This course focuses on employability aligned with CO3 and CO6
Outcomes: On completion of this course the student will be able to

- CO1: To understand of the fundamental theory of the FEA method
- CO2: To describe the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements; to understand the application and use of the FE method for heat transfer problems.

- CO3: To demonstrate the ability to create models for trusses, frames, plate structures, machine parts, and components using ANSYS
- CO4: To demonstrate the ability to evaluate and interpret FEA analysis results for design and evaluation purposes
- CO5: To develop the ability to generate the governing FE equations for systems governed by partial differential equations
- CO6: To develop a basic understanding of the limitations of the FE method and understand the possible errors our cesinits use.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO4, PO5
CO6	PO1, PO2/PSO2, PO3, PO4, PO5

MTEE 0800 : COMPUTER AIDED TRANSPORTATION ENGINEERING LAB

Objective: *This course provides practical knowledge of preparing engineering drawing of cross-sectional elements of road, drainage, alignment of horizontal and vertical curves.*

Credits: 02 **L-T-P-J: 0-0-4-0**

Module No.	Contents	Teaching Hours
I	Hands on practice on Transportation Engineering Drafting Softwares : • Bentley OpenRoads Designer • HDM4	40

Reference Books:

- https://communities.bentley.com/products/road.../video-replace-reference
- World Road Association, Guidelines for HDM – 4 Software, (2004)

Focus: This course focuses on skill developement aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to**:**

- CO1: Describe cross sectional elements of road design.
- CO2: Prepare engineering drawing using CAD tools.
- CO3: Check engineering drawings of road section.
- CO4: Validate construction at site with CAD design.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO5, PO6 / PSO1, PSO2
CO2	PO1, PO5, PO8, PO9, PO11 / PSO1, PSO2
CO3	PO1, PO2, PO3, PO5, PO8, PO9, PO10, PO11 / PSO1, PSO2
CO4	PO1, PO2, PO3, PO5, PO8, PO9, PO10, PO11 / PSO1, PSO2

MTEE 0801 : PAVEMENT MATERIALS LAB

Objective: *This course provides a comprehensive knowledge of testing of various highway materials in laboratory (as per standard IS Code)*

Credits: 04 **L-T-P-J: 0-0-4-0**

Module No.	Contents	Teaching Hours
I	**Tests on Aggregate** 1. Gradation, (IS : 2386 (Part -I) – 1963) 2. Shape Test, (IS : 2386 (Part -I) – 1963) 3. Specific Gravity, (IS : 2386 (Part -III) – 1963) 4. Water Absorption, (IS : 2386 (Part -III) – 1963) 5. Aggregate Crushing Value, (IS : 2386 (Part -IV) – 1963) 6. Los Angeles Abrasion Value, (IS : 2386 (Part -IV) – 1963) 7. Aggregate Impact Value, (IS : 2386 (Part -IV) – 1963) **Tests on Bitumen** 1. Specific Gravity Test (IS 1202-1978) 2. Penetration Value and Grade of Bitumen Test, (IS 1203-1978) 3. Softening Point Test, (IS 1205-1978) 4. Viscosity Test (IS 1206 (Part I to III) -1978) 5. Ductility Test, (IS 1208-1978) 6. Flash and Fire Point (IS 1209-1978) **Tests on Sub-grade Soil** 1. Density of soil, (IS : 2720 (Part 7) -1980 and IS : 2720 (Part 7) -1983) 2. CBR Test, (IS : 2720 (Part 16) -1987) 3. Corrections in CBR value, (IS : 2720 (Part 16) - 1987) **Test on bituminous mix** 1. Marshall Mix Design, (ASTM D 1559 (2004))	40

Reference Books:

- Highway Materials testing– S.K. Khanna & C.E.G. Justo. Nem Chand & Brothers.

Focus: This course focuses on skill development aligned with all COs

Outcome: After completion of course, the student will be able to:

- CO1: Understand tests required for road construction.
- CO2: Perform tests for aggregate, bitumen, bitumen mix.
- CO3: Evaluate the suitability of materials to be used in pavement construction.
- CO4: Prepare the report of material testing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO9 / PSO1, PSO2
CO2	PO1, PO9, PO11 / PSO1, PSO2
CO3	PO1, PO3, PO9 / PSO1, PSO2
CO4	PO1, PO8, PO9, PO11 / PSO1, PSO2

COURSE STRUCTURE

M.B.A.

CONSTRUCTION MANAGEMENT

Under

Choice Based Credit System (CBCS)

Annexure IV

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCMC0001	Project Management	3	0	0	3	3
2	MCMC0002	Construction Economics	3	0	0	3	3
3	MCMC0003	Quantity Surveying	3	0	0	3	3
4	MCMC0004	Marketing Management	3	0	0	3	3
5	MCMC0005	Construction Methods and Techniques	3	0	0	3	3
6	MCMC0006	Research Methodology	3	0	0	3	3
7	MCMC0007	Safety and Health Management	3	0	0	3	3
8	MCMC0008	Construction Equipment Management	3	0	0	3	3
9	MELH0004	Business Communication-I	3	0	0	3	3
PRACTICALS							
		Practice Workshop-2(MSP) After Exams 7 days				0	30
		TOTAL	**27**	**0**	**2**	**27**	**57**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCMC0021	Construction Materials Management	3	0	0	3	3
2	MCMC0022	Human Resource Management	3	0	0	3	3
3	MCMC0023	Building Management and Services	3	0	0	3	3
4	MCMC0024	Financial Management	3	0	0	3	3
5	MCMC0025	Conventional Construction Materials and Technology	3	0	0	3	3
6	MCMC0026	Tendering and Bidding	3	0	0	3	3
7		Elective-I	3	0	0	3	3
8		Elective-II	3	0	0	3	3
PRACTICALS							
		Practice Workshop-2(Primavera) After Exams 10 Days				0	30
		TOTAL	**24**	**0**	**0**	**24**	**54**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCMC0031	Value Engineering and Lean Construction	3	0	0	3	3
2	MCMC0032	Contract Management	3	0	0	3	3
3	MCMC0033	Special Construction Techniques	3	0	0	3	3
4	MCMC0034	Operations Management	3	0	0	3	3
5	MCMC0035	Valuation of Properties and its Strategies	3	0	0	3	3
6	MCMC0036	Infrastructure Development and Operations	3	0	0	3	3
7		Elective-III	3	0	0	3	3
8		Elective-IV	3	0	0	3	3
9		Elective-V	3	0	0	3	3
10		Summer Training Report and Viva				2	
PRACTICALS							
		Practice Workshop-(Advance Building Information Modeling) After Exams 10 Days				0	30
		Total	**27**	**0**	**0**	**29**	**57**

* **Summer Training** (6-8 Weeks in summer vacation)

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1		Elective- 6	3	0	0	3	3
2		Elective- 7	3	0	0	3	3
3		Elective- 8	3	0	0	3	3
4		Elective- 9	3	0	0	3	3
5		Elective- 10	3	0	0	3	3
6		Elective- 11	3	0	0	3	3
7		Dissertation Report and Viva				10	
		Total	**18**	**0**	**0**	**28**	**18**

Program Elective

(Construction Management, Projects, Real Estate, Infrastructure Management)

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCME0001	Ground Improvement and Foundation Engineering	3	0	0	3	3
2	MCME0039	Port Engineering and Construction	3	0	0	3	3
3	MCME0040	Infrastructure Operations Management	3	0	0	3	3
4	MCME0041	Urban Transport Planning Design and Management	3	0	0	3	3
5	MCME0042	Construction Methods in Geo-Technical Engineering	3	0	0	3	3
6	MCME0043	Urban Water and Waste Water Management	3	0	0	3	3
7	MCME0046	Principles and Practices of Real Estate Management	3	0	0	3	3
8	MCME0047	Urban Planning and Design	3	0	0	3	3
9	MCME0050	Highway Project Development	3	0	0	3	3
10	MCME0051	Environment Management System	3	0	0	3	3
11	MCME0061	Airport Construction Management	3	0	0	3	3
12	MCME0071	Technology and Management of High-Rise Structures and Special Building	3	0	0	3	3
13	MCME0081	Repair, Retrofitting and Maintenance of Structure	3	0	0	3	3

14	MCME0101	Green Building	3	0	0	3	3
15	MCME0111	Arbitration, Contracts and Claims Management	3	0	0	3	3

Program Elective
(General Management)

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MCME0031	Management of Public Private Partnership	3	0	0	3	3
2	MCME0110	E-Business for Construction	3	0	0	3	3

MCMC 0001: Project Management

Objective: *This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high-quality concrete for buildings and infrastructure.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Overview of Indian construction industry; Role of project organization; Project manager roles, responsibilities, functions, qualifications, skills, ethics, values and social responsibilities; **Construction Planning:** Introduction, activities involved types of project plan, work breakdown structure. Planning terminologies, Critical path method, forward and backward pass, PERT, Ladder network, Precedence network, Line of balance. **Project scheduling and resource leveling:** Introduction, Resource allocation and leveling for unlimited resources, Resource allocation for limited resources, Multi resource allocation, Optimal scheduling.	15
II	**Contracts Estimation and Bidding Strategy:** Introduction, Determination of bid price, Bidding models. **Project Monitoring and Control:** Introduction, Project updating, Cost control. Project site budgeting and cash flow management; Project information systems; Project communications, meetings and review; Inter- organizational relationships; Project closeout.	15

Reference Books:

- Gahlot, P.S. and Dhir, B.M. “Construction Planning and Management”, New Delhi, New Age International (P) Ltd., Publishers,. 2007.
- Chandra, P. “Project- Planning, analysis, selection, financing, implementation and review.” Tata McGraw-Hill, New Delhi. 2007.
- Joy, P. , “Handbook of construction management”, Macmillan Indian Limited, New Delhi. 2007.
- Ritz, G. “Total construction project management”. McGraw-Hill, Singapore. 1994.

Focus: This course focuses on employability aligned with CO2 and CO4

Course Outcomes:

Upon successful completion of this course, the student will be able to:

- CO1: Understand the concepts of Project Management for planning to execution of projects.
- CO2: Apply the risk management plan and analyse the role of stakeholders.
- CO3: Understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
- CO4: Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
- CO5: Explain the different databases that can be maintained in a construction industry using computers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO7 /PSO2
CO2	PO1,PO2,PO7/PSO2

CO3	PO1,PO7/PSO2
CO4	PO1,PO6,PO7/PSO2
CO5	PO1,PO6,PO7/PSO2

MCMC 0002: CONSTRUCTION ECONOMICS

Objective: *This course equips students with the skills to become senior managers, policy advisers and decision-makers in any branch of the construction industry. It can also provide researchers and teachers in these subject areas with professional academic development in order to arbitrate and assess the market mechanism (demand, supply and equilibrium process) for construction firms (including inter-state and international companies) and analyze how this affects leadership and communication within construction businesses.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Overview:** Economics background to construction management, Nature and s cope of Construction Economics, nature, characteristics, size, and structure of construction industry, economics of road and buildings, irrigation and power, ports and aviation. **Demand Analysis:** Demand Theory, Law of demand and Determinants of demand, Indifference Curve Analysis, Theory of Demand, Elasticity of Demand and its Measurement Methods. Demand Forecasting Demand Forecasting methods **Production:** Production Concepts and Analysis, Production Function, Cost Analysis: Cost Concepts and Analysis, Empirical estimates of Production and Costs, Short-run and Long-run Average Costs Curves and its Analysis	15
II	**Pricing Decisions:** Pricing under different Market Structure, Perfect and Imperfect (monopoly, monopolistic and oligopoly) markets, Pricing strategies: Collusive and Non-Collusive Oligopoly **Macroeconomics:** Science of Macroeconomics, Circular Flow of Income & Products, National Income, Concept Measurement of National Income: National Income aggregates (GDP, GNP, NNP, NDP etc.) at Factor and Market Prices, GDP-Changing trends in composition and the future, Money and Inflation **Price indices:** Wholesale Price Index, Consumer Price Index; Development economics, causes and characteristics of underdevelopment, general theories of development, Five-year planning and social development.	15

Reference Books:

- Geetika, Ghosh P., Choudhary R. P. , "Managerial Economics", Tata McGraw Hill Publication. 2009.
- Petersen, C. "Managerial Economics". Pearson Education. 2006.
- Dornbusch, R. and Fischer, S. "Macro Economics", 5th Edition. Tata McGraw Hill Publication. 2008.
- Thomas, R. C., Maurice, C. S., & Sarkar, S, "Managerial Economics", 9th Edition. Tata McGraw Hill Publication.2010.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understanding the basic concepts and scope of Construction economics and its significance in decision making process as apply micro economic principles to construction business operations.
- CO2: Illustration of concept of Production function and laws of production & Understanding the various cost functions and curves.
- CO3: Determine profit maximizing price and output for a firm in oligopoly or monopolistic Competition.
- CO4: Comparing the various market structures and pricing strategies.
- CO5: Understand how households (demand) and businesses (supply) interact in various market structures to determine price and quantity of a good produced.

- CO6: Understand the implications of interference in a market economy, including government policy.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO3
CO2	PO2/PSO3
CO3	PO2/PSO3
CO4	PO1/PSO3
CO5	PO2/PSO3
CO6	PO4/PSO3

MCMC 0003: QUANTITY SURVEYING

Objective: *This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high-quality concrete for buildings and infrastructure.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Estimate**: Purpose of estimating; Different types of Estimates; their function and preparation **Measurement of Construction works:** Specification of Construction work items; Types of Estimates; Estimation of different types of work-reinforced concrete, Structural steel, fabrication and erection, sanitary water works, building finishes and interiors. **Infrastructure construction work:** Road bridges, Tunnels, Industrial construction and power related works; Estimation of utilities and facilities; Role of a quantity surveyor.	15
II	**Specification:** Necessity, types of specification, specification for different civil engineering materials. **Role of a Quantity surveyor:** Analysis of rates schedule of rates; Taking of Quantities; Quick method for estimating; Material and labour requirements; Standard cost and variances for material and labour components; Contingency allowances as indirect cost; effect of inflation on profitability, Design of project cost control system; valuation of properties.	15

Reference Books:

- Towey D. ,"Construction Quantity Surveying A Practical Guide for the Contractor's QS" Wiley-Blackwell, 2012
- Dutta B.N., "Estimating and Costing in Civil Engineering" , UBS Publishers' Distributors Ltd 2002

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understanding about Estimating, measure, Purpose of estimating, function and preparation.
- CO2: Illustrate Construction work, Different types of working methods, Analysis.
- CO3: Infrastructure construction work, Estimation of utilities and facilities.
- CO4: Specification for different civil engineering materials.
- CO5: Description about material rates, Labour Charges.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO9/PSO3
CO2	PO3,PO6,PO17/PSO2
CO3	PO5 /PSO2
CO4	PO4,PO5 /PSO2
CO5	PO3,PO7 /PSO3

MCMC0004: MARKETING MANAGEMENT

Objective: *This course provides an understanding of various concepts of marketing management and to develop the ability to take decisions and plan, execute and control marketing strategies towards attaining of organizational goals.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Importance and Scope of Marketing, Elements of Marketing, Marketing Vs Selling, Consumer Markets and Industrial Markets, Marketing Mix, Consumer Buying Behaviour: Types, Process and Factors. **Market segmentation, Targeting and Positioning**: Segmenting Consumer and Business Markets – Bases, Purpose and Process, Market Targeting, Positioning – Nature and Importance. **Product Decisions:** New Product Planning and Development Process, Product Life Cycle: Stages & Strategies. Product Classification and Product line and length analysis. **Pricing Decisions:** Understanding Price, Approaches and types	15
II	**Promotion Mix:** Advertising, Sales Promotion, Sales Promotion techniques, Personal Selling, Public Relations, Direct Marketing, and Publicity **Channels of Distribution:** Channel of Distribution for Consumer/ Industrial Products, Functions and types. **Service Marketing:** Paradigms in Services Marketing, Importance of Customer Relationship Management, Classification of Services. **Service Quality:** Understanding Customer Expectations and Zone of Tolerance. **Relationship marketing:** Relationship- tools and strategies, Use of information technology for CRM	15

Reference Books:

- Zeithaml, A., Valarie. & Bitner, Mary, Jo. "Services Marketing", New Delhi, India: Tata McGraw Hill. 2008.
- Kotler, P., & Armstrong, G. "Principles of Marketing", 12th Edition. Pearson Education. 1999.
- Ramaswamy, V. S., & Namakumari, S. "Marketing Management: Planning, Implementation and Control: Global Perspective Indian Context", 3rd Edition. McMillan Publication. 2002.

Focus: This course focuses on employability aligned with CO2 and CO3

Outcome: After completion of course, the student will be able to:

- CO1: Students should able to understand the basic concept of Marketing and its different dimension..
- CO2: Identify and compare the various bases of segmentation and targeting for the different types of goods and services.
- CO3: Able to understand the various component of marketing mix such as product, price, place and promotion.
- CO4: Compare and contrast the various dimension of marketing mix.
- CO5: Understand the importance of service marketing and service quality.
- CO6: Explain the importance of Relationship marketing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO11/PSO3
CO2	PO1,PO2,PO11/PSO3
CO3	PO1,PO3/PSO3
CO4	PO1,PO2,PO11/PSO3
CO5	PO1,PO11/PSO3
CO6	PO1,PO2,PO3/PSO3

MCMC 0005: Construction Methods and Techniques

Objective: *To learn about recent surveying methods, formwork, modular construction practices and to understand the automation in construction industry, also about labor welfare.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Setting out of work for different structures**: Recent survey methods; Concrete batching, mixing, placement, transportation, compaction and curing methods, concreting in extreme weather conditions. **Formworks:** Various types of formworks, formwork depending for special structures, formwork design (special example Mivan Shuttering, Tabala Shuttering etc. **Reinforced and pre stressed concrete construction**: Prefab, composites structure construction, structural steel fabrication, erection method and procedures, staging and storage works	15
II	**Modular construction practices**; Site exploration methods, structures-piles, cofferdams, caissons, well foundation, shear walls; Building finishes, types of floorings and best practices, external and internal wall finishes, false ceilingsConstruction and maintenance problems and remedial measures. **Automation in construction:** Nano technology and its application; Ground improvement techniques, Soil stabilization and compaction; Rain water harvesting; Intelligent building systems. **Labour Welfare**: Labour laws in general and various Labour welfare schemes e.g. EPF, Workman Compensation Act Policy, Employee State Insurance.	15

Reference Books:

- Arora, S.P. and Bindra, S.P. "*A Text Book of Building Construction including Engineering Materials*", DhanpatRai Publications (P) Ltd., New Delhi. 2005.
- Swami, S. "*Reinforced soil and its Engineering applications ",* I.K. International, New Delhi. 2005.

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Learn about different recent surveying methods in construction.
- CO2: Define the concrete batching and related activity associated with concreting.
- CO3: Differentiate the types of form work using recently.
- CO4: Learn about Modular construction practices and structural steel fabrication
- CO5: Discuss about Automation in construction Industry
- CO6: Discuss the different labor Welfare acts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO5, PO9 /PSO2
CO2	PO1, PO9 /PSO2
CO3	PO1, PO9 /PSO2
CO4	PO1, PO9/PSO2
CO5	PO1, PO9 /PSO2

CO6	PO1,PO10 /PSO2

MCMC 0006: RESEARCH METHODOLOGY

Objective: *The primary objective of this course is to develop a research orientation among the students and to acquaint them with fundamentals of research methods. Specifically, the course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Meaning, Objectives and Motivation in Research; Types of Research; Research Approaches; Research Process. **Research Design:** Definition, classification: Exploratory, Descriptive and Causal research design, Experimental Research Design. **Measurement and Scaling:** Types of Scales, Scale Construction, Reliability and Validity of scale.	15
II	**Sampling:** Introduction, Sample and Census study, Types of Sampling. Types of data: Methods of Data collection- Observation, Interviews, Questionnaire and Schedules Data Analysis and Interpretation through SPSS and MS Excel Brief overview of multivariate data analysis techniques and its application. **Report Preparation:** Layout of Research Report, Citation and Referencing, Precautions in report writing, Plagiarism	15

Reference Books:

- Kothari, C. R. "Research Methodology", New Age International Publication. 2004.
- Copper, Donald R. " Business Research Method", Tata McGraw Hill Publishing Company New Delhi. 2004.
- Bajpai, N. "Business Research Methods. Pearson Publications", New Delhi. 2010.
- Sekaran, U. "Research Methods for Business: A Skill Building Approach", New Delhi: John Wiley & Sons Inc. New Delhi. 2008.

Focus: This course focuses on employability aligned with CO3 and CO4
Outcome: After completion of course, the student will be able to:

- CO1: Understanding of various types of research and the scientific process of conducting research.
- CO2: Understanding of types of management problems and the appropriate research designs in these problems.
- CO3: Apply the methods and scales to measure the qualitative phenomena like attitude in quantitative terms and selecting sample for conducting the research studies.
- CO4: Acquaintance of methods of collecting information and data and various merits and demerits of these methods.
- CO5: Understanding of reliability and validity in research and the basic process of testing hypothesis.
- CO6: Apply various principles of writing a research report and use of SPSS for analyzing the data.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO2/PSO3
CO2	PO2/PSO3
CO3	PO2/PSO3
CO4	PO1/PSO3
CO5	PO2/PSO3
CO6	PO3/PSO3

MCMC 0007: SAFETY AND HEALTH MANAGEMENT

Objective: *This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high-quality concrete for buildings and infrastructure.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Safety Norms: Site safety measures, personnel safety, safety equipment and devices, signage. Concept of safety, factors affecting safety: psychological and technological, planning for safety provisions, techniques for construction safety management, safety considerations during construction. Demolition and use of equipment; management of accidents/injuries, site management with regard to safety recommendations, training for safety awareness, implementation of health camp.	15
II	Construction safety management – safety plans, construction hazards camp; solutions, formulation of safety manuals, safety legislation, standards/codes with regard to construction safety, case studies, fundamentals, measuring performance & recording information. Health hazard in construction, personal protective and lifesaving equipment, the safety policy; assessing the risks, control strategies for construction work; fire safety. Health and safety plan- Training; meetings, understanding people, access to information, environment, health and safety issues construction and the environment, construction health and safety law.	15

Reference Books:

- Kelvin Molly, "Human Resource Information System", GRIN Publishing, London., 2014
- Satish K. Bagdi, *"Practical Human Resource Information Systems"*, PHI Learning, 2012

Focus: This course focuses on employability aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understanding safety norms, measure, signage, factors affecting safety and their provisions.
- CO2: Illustrate safety in demolition, site and accident management, trainings for safety management and safety awareness.
- CO3: Enumerate construction safety management, standards/codes with regard to safety.
- CO4: Identify health hazards in construction, assessing the risks, control strategies and fire safety.
- CO5: Describe health and safety plan, issues related to safety and safety laws.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO9,PO10/PSO2
CO2	PO5,PO9,PO10/PSO2
CO3	PO9,PO10/PSO2
CO4	PO5,PO9,PO10/PSO2
CO5	PO8,PO9,PO10/PSO2

MCMC 0008: CONSTRUCTION EQUIPMENT MANAGEMENT

Objective: *The objective of this course is to enable the learners to understand the concepts of equipment management, its associated aspects, selection criteria and equipment planning and maintenance. This course also aims at providing a brief introduction of different types of equipment used in construction activities and the time motion studies.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Equipment Management:** Introduction, Management Requirement, Mechanization and its need, Different aspects of Construction equipments and plants, Selection Criteria of Construction Equipment, Construction Equipment Planning **Cost of Owning and Operating the Construction Equipment**, Infrastructure planning for Mechanization, Role of Operations Research in Equipment Management, Equipment Maintenance.	15
II	**Construction Equipment:** Introduction, Classification of Construction Equipment, Earth-moving Equipment, Excavation Equipment, Excavating and Earth Moving Equipment, Earth Compaction Equipment, Hauling Equipment, Hoisting Equipment, Conveying Equipment Aggregate Production Equipment, Concrete Production Plants, Pile Driving Equipment, Tunnelling and Rock Drilling Equipment, Pumping and Dewatering Equipment **Time and Motion Studies:** General, Motion Study, Time Study, Process Charts, Applications of Time and Motion Studies, Queuing or Waiting Line Theory.	15

Text Books:

- Seetharaman S., "Construction Engineering and Management", Umesh Publications, 2005.
- Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", Tata Mc Graw-Hill Publishing Company, New Delhi, 1998

Reference Books:

- John E. Schaufelberger and Giovanni C. Migliaccio. "Construction Equipment Management", CRC Press, 2019.
- Douglas D. Gransberg, Calin M. Popescu, Richard Ryan, "Construction Equipment Management for Engineers, Estimators, and Owners", CRC Press, 2006.

Focus: This course focuses on employability aligned with CO2 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Understand management requirements and need of mechanization for equipment management.
- CO2: Explain the criteria for the selection of equipment.
- CO3: Determine the cost of owning and operating the construction equipment.
- CO4: Classify various types of construction equipment based on their function.
- CO5: Describe the time motion studies and its application in equipment management.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO6,PO7/PSO1
CO2	PO2,PO7/PSO1

CO3	PO2,PO3/PSO2
CO4	PO1,PO2/PSO1
CO5	PO1,PO2/PSO2

MELH 0004: BUSINESS COMMUNICATION

Objective: *To develop awareness of the complexity of the communication process, effective listening skills in students so as to enable them to comprehend instructions and become a critical listener, effective oral skills so as to enable students to speak confidently interpersonally as well as in large groups, effective writing skills so as enable students to write in a clear, concise, persuasive and audience centered manner.*

Credit: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Written Business Communication: Introduction, Nature & Style of Sensible Writing, Principles of Business Writing Formality, Persuasiveness and Politeness Business Letters: Letters Good and Letters Bad, Format for Business Letters, Types of Business Letters Email Writing: Style and Structure Cover Letter and Resume	15
II	Report Writing: Structure of Reports, Long & Short Reports, Formal & Informal Reports, Writing Research Reports Meetings: Procedure – Preparing agenda, Minutes and Resolutions, Memos, Circulars, Notices	15

Reference Books:

- McGrath, E. H., S.J, "Basic Managerial Skills for All", 9th edition, Prentice-Hall of India ,2011
- Guffey, Mary Ellen, "Business Communication: Process and Product", 7th edition, South-Western Cengage Learning India (P) Ltd., 2010
- Adler, R. B., Elmhurst, J.Marquardt, "Communicating at work", 11th edition, McGraw Hill Publications. ,2012

Focus: This course focuses on employability aligned with CO6 and CO4

Outcomes: After completion of the course the students will be able to

CO 1: Communicate effectively in a business environment

CO 2: Listen, comprehend and respond to native speakers

CO 3: Deliver presentations in a better way

CO 4: Write in persuasive and polite style

CO 5. Prepare long and short reports

CO 6. Prepare official documents like memo, notice, circular

Mapping of Course Outcomes (CO) with Program Outcomes (PO) and Program Specific Outcomes (PSO)

Cos	Pos/PSOs
CO1	PO2, PO7, PO8, PO9/PSO3
CO2	PO8, PO7, PO4/PSO3
CO3	PO7, PO8/PSO3

CO4	PO4, PO8/PSO3
CO5	PO4, PO7, PO8, PO9/PSO3
CO6	PO8, PO9, PO10/PSO3

MCMC 0021: CONSTRUCTION MATERIALS MANAGEMENT

Objective: *The objective of this course is to introduce the learner with the integrated approach to materials management and methods of estimating the material requirements. This course also introduces the learner with the basics of store management and various aspects of inventory/ stock control.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Overview**: Importance, scope, objectives and function of materials management; Integrated approach to materials management; Classification of construction materials. **Estimation of material requirement:** Identification of sources, vendor development, purchases procedure, legal aspects of purchasing, basics of material handling and transportation. **Construction chemicals:** Adhesives, concrete admixtures, waterproofing chemicals, sealants, grout materials, epoxy based products; Polymers in civil engineering, polymer membranes, coatings and adhesives	15
II	**Basics of store management:** Issue of materials codification; standardization, variety reduction; care and safety in handling store records and store accounting; **Inventory/Stock control:** importance, classification, models, EOQ its drawback ascertaining the EOQ and cost, safety stock, reorder level, lead time service level and other statistical applications. Basic logistic concept	15

Text Books:

- Ahuja, K. "Materials Management" ,CBS Publishers and distributors reprint, New Delhi. 2009.
- Datta, A. "Materials Management-procedures, text and cases", Prentice-Hall of India, New Delhi. 2006.

Reference Books:

- Ritz, G. "Total construction project management", McGraw-Hill, Singapore. (1994).

Focus: This course focuses on employability aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic concepts in Material Management relevant to Consumer.
- CO2: Estimate the materials requirement as per the demand.
- CO3: Explain the methods of codification, standardization and handling of materials in store.
- CO4: Classify various inventory control models
- CO5: Determine Economic Order Quantity and the cost associated.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1/PSO2
CO2	PO1,PO7/PSO2
CO3	PO1,PO6,PO7/PSO2
CO4	PO1,PO6/PSO2
CO5	PO1, PO7/PSO2

MCMC 0022: Human Resource Management

Objective: *An overview of theoretical foundations of key areas associated with HR development in the organizations, the functions, systems, policies and applications of Human Resource Management in organizations. HR skills and their ability to assess the constraints and opportunities associated with managing employees in different socio-economic and political context.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	Introduction to HRM: Different between personnel management and HRM, role of a manager –managing people, performance and interface with the environment; the conceptual basic and strategic HRM, value chain, fundamental characteristics of strategy formulation and significance; creating and managing talent pool-career development, succession planning	16
II	Human resources planning and HRIS: Designing job specifications and person specifications jobs analysis and design; Recruitment and Selection; Performance management system; Computation theories and its linkage to motivation concepts, jobs evaluation and relativities (internal and external equalities); Rewards and incentive policies and its impact cross-culture and diversity issues; Training and development systems.	16

Text Books:

- Dessler, "Human Resource Management": Pearson Education, 2018.

Reference Books:

- N.A. Raymond, J.R. Hollenbeck, B. Gerhart, P. M .Wright, "Human Resource Management", The McGraw Hill Pub, 2019.
- George W. Bchlander, Scott A. Snell, (2014), Principles of Human Resource Management, 16th edition, Cengage Learning.

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Define the concept and issues in human resource management (HRM)
- CO2: To understand HRM related social, cultural, ethical and environmental responsibilities and issues in a global context
- CO3: Identifying the practices of human resource planning, job analysis, talent acquisition, training and development, reward and incentive policies
- CO4: Analyze the key issues related to administering the human elements such as motivation, compensation, appraisal, career planning, diversity, ethics
- CO5: Illustrate the traditional and modern techniques of performance management.
- CO6: Demonstrate competence in development and problem-solving in the area of HR Management

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO9/PSO3

CO2	PO9,PO10/PSO3
CO3	PO1,PO2,PO3,PO6/PSO3
CO4	PO6,PO7,PO8,PO9,PO10,PO11/PSO3
CO5	PO6,PO8/PSO3
CO6	PO2,PO3/PSO3

MCMC 0023: BUILDING MANAGEMENT AND SERVICES

Objective: *The objective of this course is to introduce the learner with the various services involved in a building such as water and waste management services, HVAC systems, electrical service system, vertical transportation systems, and security systems. This course also develops an understanding about the operation, maintenance and planning of retrofitting works.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Water and waste management services and systems:** Water supply systems (sources, pumping, reservoirs, water treatment, tanks, pipe materials); Quality and quantity standards for water; Sewerage and Sewage Treatment Plants; R.O. system for potable water; Storm water system; Rain water harvesting; Plumbing system, fittings and fixtures; Hydro pneumatic systems; Multi-stage pumping; Measures for effective water management; Net zero water approach. **HVAC system**: Types and components; Heating and cooling load determination; District cooling; Planning and design of ventilation.	15
II	**Electrical services system and components:** Main substation and substation equipment (for large developments); Power distribution systems (underground and overhead); Standby / captive power supply, metering; Renewable energy sources. **Fire Safety and Excavation System:** Introduction **Vertical transportation system:** Elevators; travelators, escalators. **Security System:** Access control CCTV system; Security and surveillance systems; Telecommunication and related information technology-based facilities.	15

Text Books:

- Chandra, P. "Project- Planning, analysis, selection, financing, implementation and review", Tata McGraw-Hill, New Delhi 2007
- Joy, P. "Handbook of construction management", Macmillan Indian Limited, New Delhi 2007

Reference Books:

- Ritz, G. "Total construction project management", McGraw-Hill, Singapore. (1994).

Focus: This course focuses on employability aligned with CO2 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Describe water supply system and plumbing system along with their components, quality and standards of water.
- CO2: Understand the methods for the treatment of wastewater and sewage water
- CO3: Explain about the underground and overhead power distribution system
- CO4: Select the vertical transportation system as per the requirements of the building.
- CO5: Discuss about the security system and the operation and maintenance activities of the building

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1/PSO2

CO2	PO1,PO6/PSO2
CO3	PO1,PO6/PSO2
CO4	PO1,PO6/PSO2
CO5	PO1,PO6,PO7/PSO2

MCMC 0024: FINANCIAL MANAGEMENT

Objective: *The focus of this course is in the area of financial management. We will show managers how to interface with accounting and finance departments, help them to understand how firms meet their financial objectives utilizing financial decision-making. This course will also explain financial tools and techniques, which can be used to help firms maximize value by improving decisions relating to capital budgeting, capital structure, and working capital management. This course will deal with a number of related topics, including multinational financial management, risk management, mergers and acquisitions.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Basic concepts:** meaning and scope, forms of business organization; Interpretation of financial statement, ratio analysis; Source of finance, long-term and short-term finance; Working capital management, working capital policy and financing; cash management, cash budgeting and forecasting; Receivables management, terms of payment, control of receivables	15
II	**Inventory management and EOQ:** Risk and return; Time value of money; Capital structure, determining level of debt capital, factors affecting the capital structure decision; Cost of capital; Valuation of securities; Capital investment analysis, process of capital budgeting, techniques of evaluation, project cash flows, assessment of risk and appraisal; Operating and financial leverages; Economic value-added approach; Taxation concepts.	15

Reference Books:

- Block, Stanley, B., Geoffrey, A. “Foundations of financial management”, McGraw- London 2001.
- Chandra, P. , “Financial management – Theory and practice”, Tata McGraw – Hill, New Delhi, 2008.
- Damodaran, A. , “Corporate finance theory and practice”, Wiley India, New Delhi, 2008

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understanding the basic finance concepts like cash-flow, time value of money, return, and risk as the building blocks of finance theory.
- CO2: Identifying the financial viability of a capital budgeting exercise in various situations and application in decision making.
- CO3: Identifying the various cost of capital its component and methods of calculation.
- CO4: Understand the theories of the relationship between capital structure and the value of the firm.
- CO5: Outlining the issues of dividend policy and the logic of dividend relevance and its irrelevance.
- CO6: Identifying valuation management, value-based management and relevant factors that have bearing on the management of working capital.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO3

CO2	PO2/PSO3
CO3	PO2/PSO3
CO4	PO1/PSO3
CO5	PO2/PSO3
CO6	PO3/PSO3

MCMC 0025: CONVENTIONAL CONSTRUCTION MATERIALS AND TECHNOLOGY

Objective: *To equip students with the latest developments in construction materials with a view to enhance their knowledge of construction practices.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Study of advances in building and construction materials**: Selection and compatibility; Alternate to bricks; New trends in painting, plumbing and flooring; Use of fiber glass, Ferro cement; Glazing and cladding materials; Importance of sustainable materials; **Construction chemicals:** Adhesives, concrete admixtures, waterproofing chemicals, sealants, grout materials, epoxy based products; Polymers in civil engineering, polymer membranes, coatings and adhesives;	15
II	**Recent developments in concrete and steel**: Geo polymer concrete, lightweight concrete, high performance concrete, fiber reinforced concrete, polymer concrete; Recent developments in reinforcing and structural steel, corrosion of steel in concrete and protective methods; Latest shuttering and formwork systems for construction of various structures, economics of form work.	15

Reference Books:

- Ashby, M., Jones, D. "Engineering materials – An introduction to properties, applications and design". Elsevier Ltd, USA, 2005.
- Berge, B. "Ecology of building materials". Architectural Press, London, 2009.
- Chudley, R. , "Construction technology", Volume 2, Pearson Education, Malaysia. (1994)
- Tliston, U. "Construction materials, their nature and behaviour". E & FN Spon, London, 2001

Focus: This course focuses on employability aligned with CO1 and CO4

Course Outcomes:

Upon successful completion of this course, the student will be able to:

- CO1: Understand various conventional construction materials, properties and their uses
- CO2: Describe various latest and modern construction materials, properties and their uses
- CO3: Understand the general construction processes and their sequences
- CO4: Understand the various techniques which are useful for the substructure construction
- CO5: Understand the various techniques which are useful for the superstructure construction

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO7 /PSO2
CO2	PO1,PO4 ,PO7/PSO2
CO3	PO1,PO7/PSO2
CO4	PO1,PO7/PSO2
CO5	PO1,PO7/PSO2

MCMC 0026: TENDERING AND BIDDING

Objective: *To study and develop comprehensive approach to tendering and contracting for infrastructure development.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Tender:** Preparing sound tender documents; detailing of complex work and expected quality through technical/commercial conditions. Selection of consultants service, prequalification and registration contractors, vendors and sub-contractors, office engineering **Preparation of Documents:** Bid invitation, E-tendering, Bid/No bid analysis, preparation and submission of bids, two package system, Tenders for LCB, NCB and ICB	15
II	Rights and obligations in tendering, Pre-bid conference and site surveys, Tender structure for different types of contracts. **Preparing prequalification documents:** Study of contract conditions for bidding, Bank guarantees and performance bonds, Payment terms, Letter of acceptance and contract signing. Contract laws, Indian Contract act	15

Reference Books:

- Indian Contract Act 1892
- FIDIC, FIDIC tendering procedure, FIDIC Switzerland, 1994.
- Patil. B. "Building and engineering contracts", S.B.Patil publication, 2011

Focus: This course focuses on employability aligned with all COs

Course Outcomes:

Upon successful completion of this course, the student will be able to:

- CO1: Explain the fundamentals of the contracting process including how to identify suitable projects and subcontractors and commence the bidding process
- CO2: Understand the differing terminology used as part of the contracting process and use key guidelines to rate the suitability of each project based on the tendering process
- CO3: Outline and understand the tendering roadmap, identify opportunities and obstacles at each stage of the process and plan ahead for successful contracting
- CO4: Prepare a thorough contract with all necessary costing, planning, and considerations built-in
- CO5: Create a successful sourcing strategy for the use of sub-contractors

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO7 /PSO2
CO2	PO1 ,PO7/PSO2
CO3	PO1,PO7/PSO2
CO4	PO1, PO7/PSO2
CO5	PO1, PO7/PSO2

MCMC 0031: VALUE ENGINEERING AND LEAN CONSTRUCTION

Objective: *To provide exposure to students on the concepts of lean construction and principles of value engineering and application of these concepts in construction projects.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Concept of Cost:** Value and worth, life cycle costing; Functions, cost and worth functions; FAST technique; ABC analysis **Application of value engineering in construction:** constructability, review of drawings, organization of value engineering exercise for construction projects, role of stake holders, profit sharing, case studies	15
II	**Lean theory:** principles of lean production, Elements of Toyota production system, Apply lean thinking to construction, lean project delivery system, relational contracting. **Lean design:** tools and techniques- last planner, kaizen, value stream mapping, case studies	15

Reference Books:

- Corfe, C. and Clip, B., " Implementing lean in construction: Lean and the sustainability agenda", CIRIA, 2013.
- Shang Gao and Sui Pheng Low, "Lean Construction Management: The Toyota Way", Springer, 2014.
- Tenah, K.A. "The Construction Management Process", Reston Publishing Company, Inc. Virginia, 1985
- Dell'Isola, Alphonse. "Value Engineering: Practical Applications." R.S. Means Company, Inc: Kingston, MA, 1997.

Focus: This course focuses on employability aligned with CO2 and CO4

Course Outcomes:

Upon successful completion of this course, the student will be able to:

- CO1: Establish value engineering techniques and methodology
- CO2: Draw value engineering job plan and work plan phases
- CO3: Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.
- CO4: Apply lean techniques to achieve sustainability in construction projects.
- CO5: Apply lean construction techniques in design and modeling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO7 /PSO2
CO2	PO1,PO2,PO7/PSO2
CO3	PO1,PO7/PSO2
CO4	PO1,PO6,PO7/PSO2
CO5	PO1,PO6,PO7/PSO2

MCMC 0032: CONTRACT MANAGEMENT

Objective: *The objective of this course is to introduce the learner with the various types of national and international contracts involved in the construction projects with a special emphasis on the general and special conditions of the construction contracts. This course also develops an understanding of the roles and responsibilities of the various stakeholders involved in a project and also enable them to learn about the claim management process.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Construction Contracts and Specifications:** Introduction to Contracts, Contract documents, Types of contract, Specifications and its meaning, Study of general and special conditions of a representative contract document for CPWD and M.E.S. **Introduction to FIDIC** (Fédération Internationale des Ingénieurs Conseils, or later, the International Federation of Consulting Engineers), Comparative study of Red book, Silver book and Yellow book, FIDIC conditions.	14
II	**Role of Engineer, Contractor and Employer in contract management:** Contract appreciation documents; Dispute prone conditions/clauses in contract, variations, payments, quality etc. **Claim Management;** Raising and defending claims, Issues responsible for claims, Documents and documentations; Limitation, Act, Breach of contract, Alternate dispute resolution systems, Arbitration and Conciliation Act, 1996.	16

Reference Books:

- Kuchaal M.C., Kuchaal V, "Mercantile Law",11 thedition,VikasPublishing House Pvt.Ltd. 2016
- Gulshan S. S. and G K Kapoor, "*Business Law including Company Law*", New Age International Publishers, 2016

Focus: This course focuses on employability aligned with CO4 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Understands the contract documents.
- CO2: Differentiate between the various types of contracts.
- CO3: Interpret the conditions of the contract documents.
- CO4: Identify the dispute prone conditions and clauses in contracts
- CO5: Describe the Claim management process.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO7/PSO2
CO2	PO1,PO6/PSO2
CO3	PO1,PO6,/PSO2
CO4	PO1,PO6/PSO2
CO5	PO1,PO6,PO7/PSO2

MCMC 0033: SPECIAL CONSTRUCTION TECHNIQUES

Objective: *The main objective of this course is to make the student aware of the various construction techniques, practices and the equipment needed for different types of construction activities. At the end of this course the student shall have a reasonable knowledge about the various construction procedures for sub to super structure and also the equipment needed for construction of various types of structures from foundation to super structure.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Advanced foundation construction;** Instrumentation in geotechnical engineering; Pre and post-tensioned construction technology for multi-storeyed buildings; Discussion of Case Studies. **Construction of flexible and rigid pavements**, low-cost road constructions; Construction of different types of water reservoirs, dams and canals; Construction of towers, silos and chimneys; Discussion of Case Studies.	16
II	**Coastal and offshore structures -** marine geotechniques, construction of docks, jetties and breakwaters; Fender systems; Shore protection structures; Dredging operations; Discussion of Case Studies. **Construction of terminal pavements**, container terminals and oil terminals; Offshore oil and gas exploration and production structures; Onshore and offshore pipelines. Discussion of Case Studies.	14

Text Books:

- Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", 5th Edition, McGraw Hill, Singapore, 1995.
- Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", Dhanpat Rai and Sons, 1997.
- Varghese, P.C. "Building construction", Prentice Hall of India Pvt. Ltd, New Delhi, 2007.

Reference Books:

- Jha J and Sinha S.K., "Construction and Foundation Engineering", Khanna Publishers, 1999.
- Sharma S.C. "Construction Equipment and Management", Khanna Publishers New Delhi, 2002.
- Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 2012.
- Mahesh Varma, "Construction Equipment and its Planning and Application", Metropolitan Book Company, New Delhi, 1983.

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understanding different types of advanced foundations and uses of various instruments in geotechnical engineering. Pre- and post-tensioned construction technology for multistoried buildings.
- CO2: Illustrate low-cost construction of flexible and rigid pavements.
- CO3: Enumerate construction of different types of water reservoirs, dams and canals, towers, silos and chimneys.
- CO4: Identify coastal and offshore structures. Construction of docks, jetties and breakwaters, Fender systems, Shore protection structures and Dredging operations.
- CO5: Describe construction of terminal pavements, container terminals and oil terminals. Offshore oil and gas exploration and production structures, onshore and offshore pipelines.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO5/PSO1
CO2	PO1,PO7/PSO2
CO3	PO1,PO10/PSO2
CO4	PO1,PO5/PSO1
CO5	PO1,PO5/PSO1

MCMC 0034: OPERATIONS MANAGEMENT

Objective: *In today's highly competitive era firms are using different management practices to enhance its efficiency. It has become very important to understand the nature of different work and the ways to manage them effectively and efficiently. In the same regard this course has been designed, which will cover various aspects of Operations Management. The students are required to review the fundamentals of Operations Management, so that they will be able to practice applications of Operations Management in corporate world.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Introduction to Operation Management: Introduction, Objectives and Scope of Operation Management, Operating System – Classification, Facilities and Capacity Planning: Introduction, Need for Selecting a Suitable Location, Plant Location and Layout design (Introduction of SLP; ALDEP; CORELAP); Learning Curve and Location Analysis, Analytic Hierarchy Procedure (AHP). Inventory Management: Objectives; Models (JIT, VED & ABC analysis); Service level and Safety stock; Material Requirements Planning (MRP); Bill of Material (BOM) and Master Production Schedule (MPS). Safety stock	15
II	Production shop- Types, Assembly lines, Theory of Constraints; Planning Process: Aggregate planning; importance and strategy- Chase and Level strategies; Medium term capacity management; manipulation in demand and supply. Operations Scheduling: Job order scheduling; heuristic for design rule; Moore's, Johns procedure; Work Study: Meaning, Productivity & work- study; Method:Time- study, Motion/ Method study; wage incentive plans; Break even analysis; Forecasting.	15

Reference Books:

- C R. Panneerselvam, "Production and Operations Management", 3rd edition, PHI, 2013
- Stevenson W.J, "Operations Management", 12th edition, McGraw Hill , 2015
- Richard B. Chase, F. Robert Jacobs, Nicholas J. Aquilano, "Operations Management for Competitive Advantage", 11th edition, McGraw-Hill, 2006
- E.S. Buffa, "Modern Production / Operation Management", 8th edition, Wiley , 2007

Focus: This course focuses on employability aligned with CO2 and CO3

Outcome: After completion of course, the student will be able to:

- CO1: Understanding objectives and scope of operations management at work place.
- CO2: Illustrate basic frame work and complexity of different operations in organization.
- CO3: Enumerate different plant layouts and its utility.
- CO4: Identify and understand material management in context to inventory handling and different operation scheduling.
- CO5: Able to understand and describe planning process and its association with operations management

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO9/PSO1

CO2	PO2,PO3,PO4/PSO1
CO3	PO4,PO5/PSO2
CO4	PO2,PO5,PO6/PSO2
CO5	PO9,PO10, PO11/PSO2

MCMC 0035: VALUATION of PROPERTIES AND ITS STRATEGIES

Objective: *This course provides a comprehensive knowledge to students about the valuation of a property, various methods to find the value and importance of valuation in various real estate agencies.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Value, Valuation and importance of value, Appraisal/valuation cycle, Valuation principles and factors, Major approaches to valuation – Market approach, Cost approach and Income approach, Valuation techniques/methods (Sales comparison/Cost/Income/Sinking fund/Residual development/Rent based);	15
II	Investment value and Discontinued Cash Flows (DCF) approaches, Concepts Of Yield and Sinking Fund, Valuation of freeholds, life estate and leaseholds, valuation of land, residential and commercial property, valuation of special purposes viz., rent control, compulsory purchase and industries, valuation for contemporary issues viz., energy and environment, contemporary issues in valuation. Valuation cases, tables and report writing.	15

Reference Books:

- Sacrett, D. "Property valuation", Routledge press, London, 2008
- Datta, S. "Valuation of real properties", Eastern law house, New Delhi, 2004
- Nanavati, R. "Theory and practice of valuation", Lakhani book depot, Mumbai, 2006
- Rangwala, S. "Valuation of real properties", Charotar publishing house, Anand, 2003
- RICS, "valuation – global standards" 2017, RICS London

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the importance of project appraisal
- CO2: Learn various approaches and methods of valuations of tangible and intangible properties
- CO3: Learn about various growing market sectors of construction management wherein the demand of the potential candidate is exponential
- CO4: Identify various issues encountered while valuating a property
- CO5: Learn to demonstrate the valuation done/report writing

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO9, PO10/PSO3
CO2	PO1,PO7,PO9,PO10/PSO3
CO3	PO1,PO9,PO10/PSO3
CO4	PO1,PO7,PO9,PO10/PSO3

CO5	PO1,PO8,PO9,PO10/PSO3

MCMC 0036: INFRASTRUCTURE DEVELOPMENT AND OPERATIONS

Objective: *This course provides a comprehensive knowledge of benefits of infrastructure developments, challenges, government policies and sustainability aspects.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Impact of infrastructural development on economic development and growth of the nation, public sector and governmental involvement in infrastructural activities. Overview, current status and challenges of various infrastructure sectors - energy (oil and gas, renewable energy, thermal power, hydroelectric power, nuclear power) transportation (highways, railways, waterways, airways), urban infrastructure and irrigation (dams, channels and canals, etc.);	16
II	Government policies regulation, 5 year plans and impact on infrastructure development; infrastructure institutions, financing, means, investment norms and regulation; Infrastructure projects- phases, issues, planning, evaluation, social, environmental and sustainability aspects; Construction of infrastructural projects. Discussion of case studies.	16

Reference Books:

- Arunachalam, P, "Special Economic Zone in India", Serials Publications, New Delhi, 2007
- Jetti, K. Narinder and Vishal Sethi, "Infrastructure Development in India", NewCentury Publications, New Delhi, 2007
- Aggarwal S. K., "Regional Development and Planning in India", Concept Publishers,New Delhi,2007
- Mahajan, O.P., "Economic Planning and Regional Development in India", EssEss Publications, New Delhi, 2007
- Kumari. A, "Balanced Regional Development in India; Issues and Policies", New CenturyPublications, New Delhi 2006

Focus: This course focuses on employability aligned with CO2 and CO1

Outcome: After completion of course, the student will be able to:

- CO1: Understanding Impact of infrastructural development on economic development and growth
- CO2: Illustrate current status and challenges of various infrastructure sectors
- CO3: Enumerate government policies regulations
- CO4: Identify impact on infrastructure development
- CO5: Describe infrastructure projects, their phases, issues, planning, evaluation, social, environmental and sustainability aspects

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO4/PSO2
CO2	PO1,PO4/PSO2
CO3	PO1,PO4/PSO2
CO4	PO1,PO7/PSO2
CO5	PO4,PO7/PSO2

MCME 0001: GROUND IMPROVEMENT AND FOUNDATION ENGINEERING

Objective: *To make the students aware of techniques of soil improvement for different types of soils, and help them assess the appropriate selection of foundation types, to be used before launching actual project works.*

Credits:03 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Ground Improvement:** Need and objective for ground improvement, fundamental soil behavior and soil improvement; Role of ground improvement in foundation engineering. **Ground Improvement Techniques:** Selection of improvement techniques; Ground improvement in granular soil, cohesive coil, grouting and soil reinforcement; Soil stabilization;	15
III	**Site investigation and Soil exploration:** Principles of boring and drilling method; Clearing the bore holes, sampling and sample handling, interpretation of data; Geophysical methods; **In-situ tests:** SPT, SCPT, DCPT, field vane shear, plate load test; **Foundation:** Function, essentials, principles, challenging problems, classification (flexible, rigid, shallow and deep foundations); Selection of type of foundation, factors for failures; Foundation design aspects; Case studies and remedial measures.	15

Text Books:

- Korner, R. "Design with geosynthetics" New Jersey: Prentice Hall; 2002.
- Murthy, V. "Principles and practices of soil mechanics and foundation engineering" New Delhi: Dhanpat Rai Publications, 2002.
- Purushothama, R. "Ground improvement techniques" New Delhi: Tata McGraw-Hill; 1995.

Reference Books

- Bowles, J. "Foundation analysis and design" New York: McGraw-Hill; 1996.
- IS Code 1309-4-1992 Selection of ground improvement techniques for foundation in weak soils-Guidelines. BIS, India.
- Kasmalkar, J. "Foundation engineering" Pune: Vidyarthi Griha Prakashan; 1997.

Focus: This course focuses on employability aligned with CO2 and CO4

Course Outcomes: After completion of this course, student will be able to:

- CO1 Understand the need of Ground Modification/Improvement
- CO2 Asses the mechanical/physical modes of ground improvement
- CO3 Identify the effectiveness of drainage on soil densification
- CO4 Learn the chemical modes of ground improvement: admixtures
- CO5 Asses the improvement of soil under existing structure

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO9/ PSO1
CO2	PO1, PO2, PO3, PO9, PO11/ PSO1
CO3	PO1, PO2, PO3, PO5, PO9 / PSO1

CO4	PO1, PO2, PO3, PO9 / PSO1
CO5	PO1, PO2, PO3, PO5, PO9 / PSO1

MCME 0039: PORT ENGINEERING AND CONSTRUCTION

Objective: *To impart knowledge on harbor and port engineering considering the port layout and construction of infrastructure.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction and Fundamentals:** Ports and harbors – an infrastructure layer between two transport media, planning of ports and harbors. The fundamentals: Tide and current conditions inside harbor, water circulation; breakwaters, jetties and quay walls; mooring, berthing and ship motion inside the port; model studies, physical and mathematical studies. Growth and regulation of ports. Various components of maritime systems, including shorefront and inland infrastructure, Docks and Repair facilities, Concepts of port and marine terminal design, cargo handling equipment and intermodal transportation networks.	15
II	**Design issues:** Sea port layout with regards to (1) wave action (2) siltation (3) navigability, berthing facilities. **Design of Port Infrastructures:** Design of port infrastructures with regards to (1) cargo handling (2) cargo storage (3) integrated transport of goods, planning multipurpose port terminals. Planning and construction expansion and renovation of port and Inland **Marine and offshore construction equipment:** Basic motions of swaway Barges, crane barges, Offshore derrick barges, semisubmersible barges, Jack-up construction barges, launch barges, pipe laying barges, floating concrete plant. Pile driving equipment.	15

Tect Book:

- Qinn, A.D. "Design and construction of Ports and Marine Structures", Mc Graw-Hill 2008

Reference Books:

- Gerwick Ben C. "Construction of marine and offshore structures", CRC Press Tayler and Francis 2015
- Bray, R.N. , Bates A.D., "Dredging: A Handbook for Engineers" John Wiley & Sons, Inc. 2014
- Agershou. H., "Planning and Design of Ports and Maritime Terminals" Thomas Telford, 2018

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Explain the significance of ports and harbors as a mode of transport.
- CO2: Demonstrate the fundamental principles of wave hydrodynamics inside harbor.
- CO3: Demonstrate the basic design of port layout
- CO4: Design, plan and integrate port and harbor infrastructure.
- CO5: Explain the construction, maintenance and renovation aspects of ports and inland waterways

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO9,PO10/PSO1
CO2	PO9,PO10/PSO1
CO3	PO9,PO10/PSO2
CO4	PO5,PO9,PO10/PSO1,PSO2

CO5	PO8,PO9,PO10/PSO2

MCME 0040: INFRASTRUCTURE OPERATIONS MANAGEMENT

Objective: *To give the comprehensive knowledge of the operations and management of different typical infrastructure projects, and understand the aspects of planning, execution and operations of projects.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Transportation- highway toll collection strategy and law enforcement, Maintenance review of toll rates and structuring to suit traffic demand; Railways - mass rapid transit system, light rail transit, multimodal transport systems; Harbors and ports - cargo handling operations and equipment in these terminals; Airports- cargo terminal, military airbases, terminal management;	15
II	Irrigation – large and small dans, instrumentation and monitoring of water levels: Sanitation collection system of municipal wastewater, sewerage treatment (primary and secondary), recycling and reuse of domestic wastewater: Oil and Gas- operation of Oil and Gas value chain from well-head to retail outlet; Power- thermal, nuclear, renewable and hydro power generation, transmission, distribution and operation and maintenance aspects.	15

Reference Books:

- Garber, N.J., Hoel L.A., "Traffic and highway engineering", Thomson Learning, USA, 2002
- Khagram, S. "Dams and development- Transnational struggles for water and power" Oxford University Press, New Delhi, 2004
- Kiameh, P. "Power Generation Handbook", McGraw-Hill, New York.
- Nag, P."Power plant engineering". Tata McGraw-Hill, New Delhi 2001.
- Narsimhan, S., Kathiroli, S., Nagendra B., "Harbour and coastal engineering (Indian Scenario)" Volume I and National Institute of Ocean Technology, Chennai, 2002
- Singh, S., Banerji, P., "Large dams in India. Indian Institute of Public Administration", New Delhi, 2002

Focus: This course focuses on employability aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understanding toll strategies and rates
- CO2: Illustrate mass rapid transit system
- CO3: Enumerate harbors, ports, and airport transit system
- CO4: Identify irrigation monitoring and sanitation collection system
- CO5: Describe oil and gas, power transmission, distribution and operation and maintenance aspects

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO5,PO7,PO9/PSO2
CO2	PO5,PO8/PSO2
CO3	PO7,PO9/PSO2
CO4	PO5,PO9,PO10/PSO2
CO5	PO7,PO8,PO9/PSO2

MCME 0041: URBAN TRANSPORTATION PLANNING DESIGN AND MANAGEMENT

Objective: *This course provides knowledge of transportation system planning for urban areas including the use of modern IT tools for transportation systems.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction :** Transport and socioeconomic activities; Historical development of transport; Transportation in the cities; Freight transportation; **Urban Transportation :** Forecasting transportation needs of urban areas; Urban transportation system planning conceptual aspects; Transport planning process, problem definition, solution generation, solution analysis, evaluation and choice, implementation, sequence of activities involved in transport analysis;	15
II	**Travel demand Forecasting :** Trip generation, trip distribution, mode choice, trip assignment; Urban and intelligent transportation systems: urban transportation issues, use of IT Systems, and IT applications in transportation.	15

Reference Books:

- Papacoastas, C., Prevedouros, P. , "Transportation engineering and planning", Prentice-Hall of India, New Delhi, 2006..
- C. S. Papacostas and P. D. Prevedouros, "Transportation Engineering and Planning", Trans Tech Publications
- Hutchinson, B.G., "Principles of Urban Transport Systems Planning", Mc Graw Hill Book Company, New York, 1974.
- Akiva, B., Lerman S, "Discrete choice analysis Theory and application to travel demand", The MIT Press, Cambridge, Massachusetts, 1985.
- Hutchinson, B., "Principles of urban transport systems planning", McGraw-Hill Book Company, London, 1974.

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

- CO1 : Describe needs of transportation in urban areas.
- CO2 : Illustrate Urban Transportation system planning and conceptual aspects
- CO3 : Demonstrate use of IT systems in urban areas
- CO4 : Classify sequence of activities involved in transportation analysis.
- CO5 : Conduct four stage modelling for Traffic demand.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO9, PO10 / PSO1
CO2	PO1, PO2, PO3, PO5, PO9, PO10/ PSO1
CO3	PO1, PO2, PO4, PO5, PO6, PO8, PO9, PO10 / PSO1
CO4	PO1, PO9, PO10 / PSO1

CO5	PO1, PO2, PO3, PO5, PO8, PO9, PO10 / PSO1

MCME 0042: CONSTRUCTION METHODS IN GEO-TECHNICAL ENGINEERING

Objective: *The course provides a comprehensive learning of different type of construction practices and their suitability related to geotechnical engineering*

Credits:03 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Advanced foundation engineering, foundations of buildings under reconstruction, instrumentation in geotechnical engineering; Highway construction, highway construction materials, construction of flexible and rigid pavements, low-cost road construction, IRC and MORTH specifications; Dams, construction methods for different types of dams; Foundation construction and embankment construction, construction of various components of dam;	16
II	Ports, survey and dredging operations; Construction of docks and jetties, fender systems, terminal pavements, container terminals and oil terminals; Material handling systems; Oil and gas related construction, exploration, production stations, cross country pipelines; Refinery erection and installation.	15

Text Books:

- Chudley, R., Greeno R., "Advanced construction technology", Pearson Education, UK, 1999.
- Gerwick, C., "Construction of marine and offshore - structure", CRC Press, New Delhi., 2000
- John, C., "Management, machines and methods in civil engineering", John Wiley & Sons, New Jersey, 1981.

Reference Books

- Resource Systems International, "Rigging for commercial construction. Reston Publications, USA,1985.
- Varshney, R., Singh B., "Engineering for embankment dams", Oxford and IBH, New Delhi, 1995.

Focus: This course focuses on employability aligned with CO2 and CO5

Course Outcomes: After completion of this course, student will be able to:

- CO1 Learn the basics of soil exploration and site investigation
- CO2 Learn the use of various instrumentation in geotechnical construction
- CO3 Understand the construction procedure of a foundation
- CO4 Understand the construction procedure and requirements of an earthen dam
- CO5 Learn the requirements of a earth retaining structures

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO5, PO9/ PSO1
CO2	PO1, PO2, PO5, PO9/ PSO1
CO3	PO1, PO3, PO9 / PSO1

CO4	PO1, PO2, PO3, PO9 / PSO1
CO5	PO1, PO2, PO9/ PSO1

MCME 0043: URBAN WATER AND WASTE WATER MANAGEMENT

Objective: *The aim of urban water management is to create cities and towns that are resilient, live able, productive and sustainable, provide water security through efficient use of the diverse water sources available and the objective of waste water management is to ensure the protection of the environment through effective waste management measures. To protect the health and wellbeing of people by providing an affordable waste collection service.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Components of Urban Infrastructure Growth of Urban Infrastructure – Changing trends over the past 50-30-10-5 years Water and Sanitation issues in India. Concept of Integrated Urban Water Management, influencing Factor and associated issues for the rapid urbanizations. Components of IUWM and its significance in Indian scenario, Water Supply: Surface water, Ground Water; Rainfall and climate patterns	15
II	Introduction: Main objectives and components of water transport and distribution systems. Water Demand: Categories, patterns, calculation, forecasting. Introduction to water governance and policies. Introduction to Quality and Standardization, Overview and challenges to urban areas Introduction of Solid Waste management and its significance in rapid urbanization in developing countries	15

Reference Books:

- Garg S.K. *Water Supply Engineering (Environmental Engineering Vol.-I)*New Delhi:Khanna Publisher; 2008.
- Punmia, B. C., Jain, A. and Jain, A., "*Water Supply Engineering*", Laxmi Publications (P), Bangalore, 2010
- Fair, G.M., Geyer J.C and Okun,"Water and Waste water Engineering" Vol II, John Wiley Publications, 1969.
- Weber W.J.,"Physico -Chemical Processes for Water Quality Control", 1975

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Learn the sources and characterization of drinking water
- CO2: Understand the Dynamics of Water Purification and type of treatment required with respect to water characteristics
- C03: Develop knowledge of waste water management and urban localities
- CO4: Plan for water management of any urban area

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1

MCME 0046: PRINCIPLES AND PRACTICES OF REAL ESTATE MANAGEMENT

Objective: *This is a foundation course to introduce students to the theoretical frame-work of the real estate and urban infrastructure sector. Students are exposed to fundamentals of demand, legal aspects, financing and professional practice issues.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	The real estate market; Demand and supply; Characteristics of real estate; Real property and the law; Concept of home ownership, affordable housing; Agency; Real estate brokerage; Interests in real estate; Forms of real estate ownership; Legal descriptions; Real estate contracts.	15
II	Real estate financing - principles; Leases; Fair housing and ethical practices; Environmental issues and the real estate transaction; Real estate investment; Urban transportation and land values.	15

Reference Books:

- Galaty, et.al. "Modern real estate practice", Dearbom, USA, 1999.
- Geschwender, A. , "Real estate- principles and practices", Thomson South Western, USA, 2008.
- Miller, N. and Geltner D., "Real estate principles for the new economy", Thomson, USA, 2005.

Focus: This course focuses on employability aligned with CO2 and CO3

Outcome: After completion of course, the student will be able to:

- CO1: Understand most important elements of real estate development projects and how this can be related to a sustainability perspective
- CO2: Conduct independent assessments and analyzes of the projects
- CO3: Understand how property development projects can be carried out and contractual issues related to this
- CO4: Conduct an independent, limited project / case study under supervision

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO9,PO10/PSO2
CO2	PO5,PO9,PO10/PSO2
CO3	PO9,PO10/PSO2
CO4	PO5,PO9,PO10/PSO2

MCME 0047: URBAN PLANNING AND DESIGN

Objective: *To enable students to have the knowledge on planning process and to introduce to the students about the regulations and laws related to Urban Planning.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Planning Process:** Principles of Planning – Types and Level of Plan, Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Surveys and Questionnaire Design. **Development Plans, Plan Formulation and Evaluation :** Scope and Content of Regional Plan, Master Plan, Detailed Development Plan, Development Control Rules, Transfer of Development Rights , Special Economic Zones- Development of small town and smart cities-case studies **Legislation, Development and Management of Urban System**: Town and Country Planning Act, Land Acquisition and Resettlement Act etc., Urban Planning Standards and Regulations, Involvement of Public, Private, NGO, CBO and Beneficiaries.	15
II	**Urban Design:** Early examples of Urban Design in classical and pre-industrial cities – Heritage and the roots of our modern concepts in urban design. Objectives and scope of urban design, Basic functions, principles and techniques. Value enhancement, aesthetics and conservation aspects. Surveys in Urban Areas, Scale in Urban design, urban mass, perceiving & mapping a city, Urban Space. Urban activity & circulation. Examples at regional, metropolitan, Urban and project level.	15

Reference Books:

- Goel, S.L , "Urban Development and Management", Deep and Deep publications, New Delhi 2002
- George Chadwick, "A Systems view of planning", Pergamon press, Oxford 1978
- Singh V.B, "Revitalised Urban Administration in India", Kalpaz publication, Delhi, 2001
- Edwin S.Mills and Charles M.Becker, "Studies in Urban development", A World Bank publication, 1986

Focus: This course focuses on employability aligned with CO4 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Describe basic issues in urban planning
- CO2: Formulate plans for urban and rural development
- CO3: Plan and analyse socio economic aspects of urban and rural planning
- CO4: Design of urban development projects.
- CO5: Manage urban development projects.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2,PO8/PSO2
CO2	PO3,PO5,PO4/PSO1
CO3	PO9,PO6/PSO1
CO4	PO7, PO10/PSO2
CO5	PO8,PO9,PO11/PSO3

MCME 0050: HIGHWAY PROJECT DEVELOPMENT

Objective: *This course will enable the prepare project report for new and up-gradation type highway road works by conducting necessary feasibility/detailed studies. Analyze the social impact of highway development projects and also determine the economic feasibility analysis for justification of investments.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Various steps of preparation and execution of road projects, Investigations for preparation of project reports for new and up-gradation of roads. Objects and scope of pre – feasibility, feasibility and detailed studies for project preparation. Typical HR structure for preparations and implementation of road projects. **Topographic surveys and investigations** for finalization of horizontal alignment and vertical profile of roads, Application of GIS. Geometric Design elements, standards and specifications for road projects. **Soil investigations** for assessing the design details of road embankments and cuts, drainage requirements and foundation of cross drainage structures.	15
II	**Traffic studies** – classified traffic volume, growth rate, projected traffic for assessing road way requirements, origin- destination characteristics and studies, Axle load / wheel load studies using weigh bridges and analysis of data for pavement design Traffic forecast - traffic growth estimation from past trends, econometric models. Common methods of traffic forecast. **Environmental and social impact** studies and assessment relevant to road up-gradation / new projects, Mitigation measures, Road safety audit. Collection of relevant data, analysis and interpretation for pre-feasibility and feasibility study reports of the proposed road project. Economic evaluation of different possible alternatives. Preparation of drawings and project reports. **Tendering process** - Preparation of tender documents for different types of road projects, tender evaluation. Preparation of Detail Project Report on road projects.	15

Reference Books:

- IRC: SP:19 - 2001, Manual for Survey, "Investigation and Preparation of Road Projects"- (first revision), Indian Roads Congress.
- IRC: SP: 30 - 1993, "Manual on Economic Evaluation of Highway"- Projects in India (first revision), Indian Roads Congress.
- IRC SP – 38,"Manual for Road Investment Decision Model"-1992, Indian Roads Congress.
- MoRTH "Specifications for Road Bridge Works"- 2001, fourth revision, Indian Roads Congress.
- MoRTH "Standard and Bidding Document Procurement of Civil Works"- Part I and II, 2000, Indian Roads Congress MoRTH "Model Concession Agreement for Small Road Projects"-2000, Indian Roads Congress.

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Prepare project report for new and up-gradation type road works by conducting necessary feasibility/detailed studies.
- CO2: Conduct the soil and material investigations to develop and understand their behavior and performance.
- CO3: Perform various traffic related studies helping to develop and finalize the project preparations and methods of forecasting traffic data.

- CO4: Analyze the social impact of highway development projects and also determine the economic feasibility analysis for justification of investments
- CO5: Prepare DPR on highway projects and get the knowledge of tendering process for the construction.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO4/PSO2
CO2	PO5,PO6,PO10/PSO3
CO3	PO4,PO5,PO6,PO8/PSO3
CO4	PO5,PO9,PO10/PSO2
CO5	PO8,PO9,PO10/PSO2

MCME 0051: ENVIRONMENT MANAGEMENT SYSTEM

Objective: *This course deals with the basic knowledge of environment and environmental pollution, role of national and international organization for protection of environment, sustainable development, Environment impact assessment and Life cycle assessment*

Credits: 03 **L-T-P-: 3-0-0**

Module No.	Content	Teaching Hours
01	Environmental management- principles, problems and strategies Environmental Pollution, Pollution- air, water, and noise pollution, control technologies, standard and tolerance, Solid waste management, Sustainable development- Implication of development projects on the eco-system-land, water and air, Protection of forests, fauna, fisheries and wild life, Initiatives at the international and national levels for protection of environment and ecology, Role of UNDP, ILO, WTO, World Bank, NGOs, and national governments, Global Protocols, Policies, laws and administrative framework for protection laws governing environment, ecology, forest, habitat.	16
02	Environment impact assessment (EIA), environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India, Preparation of EIA report, Environmental audit, definitions and concepts, environmental audit versus accounts audit, compliance audit, methodologies and regulations, Introduction to ISO and ISO 14001, Life cycle assessment.	16

Reference Books:

- Peavy, H. S., Rowe, D. R. and Tchobanoglous, G., Environmental Engineering, McGraw-Hill International Ed., 1985.
- Rao, M. N. and Rao, H. V. N., “Air pollution”, Tata McGraw-Hill Publishing Co; Ltd, New Delhi, 1993.
- Rao, C. S., “Environmental Pollution Control Engineering”, New Age Int. Pubs, 1991, Reprint, 2005.
- Pandey V., “Noise Pollution”, Meerut Publishers, 1995.
- Tchobanoglous, G., Theisen and Vigil, “Integrated Solid Waste Management: Engineering Principles and Management Issues”, McGraw Hill, 1993

Focus: This course focuses on employability aligned with CO2 and CO1

Outcome: After completion of course, the student will be able to:

- Understand the concept of environmental management
- Evaluate the impact of development activities on environment.
- Analyze the environment risk and its assessment
- Understand Environment impact assessment and Life cycle assessment

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO6,PO7 /PSO1
CO2	PO6,PO7 /PSO1
CO3	PO6,PO7 /PSO1

CO4	PO6,PO7 /PSO1

MCME 0061: AIRPOrT CONSTRUCTION MANAGEMENT

Objective: *To provide the students with the understanding of the various components of an airport, function and features, and design philosophies and to equip them with competencies required to manage airport construction projects.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Role of air traffic and airports;** Designation of airports- international airports, domestic airports, Civil enclaves, commercial airbase; **Recent sector developments;** Airport land use and master planning; site selection and design factors; components and layout; **Codes for design and construction;** Geometric design and airport zones; functions and features of passenger flow; functions and features of cargo handling; Layout planning.	15
II	**Aerotropolis developing an airport city;** phasing; project delivery system; Airside safety rules and regulations; construction of runway, taxiway, aprons and hangars; Air traffic control network and visual aids; Planning and construction of airport access, terminal building; **Greenfield Vs. Brownfield construction**; managing environment impact.	15

Text Books:

- Ashford, N., Mumayiz., Wright, P, "*Airport Engineering",* John Wiley & Sons, New Jersey, 2011
- Graham, A., "*Managing Airports",* Butterworth Heinemann, Oxford, 2003
- Khanna, S., Arora, M., Jain, S., " *Airport Planning and design.* Nemchand and brothers, Roorkee, 1994

Reference Books:

- Sproule, W., Seth, Y., "*Planning and design of airports"* McGraw-Hill, Columbus 2010
- Wells, A., Seth, Y., "*Airport planning and management".* McGraw-Hill, Columbus, 2004

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

CO1: Learn about different types of airports.
CO2: Discuss about different construction methods.
CO3: Understand the safety rules and regulations at airports.
CO4: Learn about different Codes used for airport design and planning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO9 /PSO2
CO2	PO1, PO5, PO9 /PSO2
CO3	PO1, PO10 /PSO2
CO4	PO1, PO8/PSO2

MCME 0071: TECHNOLOGY AND MANAGEMENT OF HIGH-RISE STRUCTURES AND SPECIAL BUILDING

Objective: *The Course highlights for need for high-rise buildings, various aspects of high-rise and special buildings, construction, technologies, materials, safety and quality.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Definition, Classification and Characteristics of high-rise (Residential, Commercial, Hospital, Hospitality) and special structures (Industrial, Institutional, Green and intelligent building etc.). **Components:** Sub-structure, super structure, services, façade, formworks **Construction Technology:** Industrial Structures: technology, execution and erection, pre-engineered buildings, selection of technologies for different elements	15
II	**Cost-effective construction:** technology, materials and economics **Special construction technologies**: deep foundations in high rise, top down construction, use of automation and robotics Special Industrial Structures Machine foundation: types, construction, technology for block type machine foundation Basements, waterproofing, earthquake resistant construction	15

Text Books:

- Brian, C; "Construction Practice", Wiley-Black Well, U.K.
- Chew L; Michael; "Construction Technology for tall buildings", World Scientific, Singapore.
- Chudley, R., Greeno R., "Advanced Construction Technology", Pearson Education.
- Srinivasulu P, Vaidyanathan C, "Handbook of Machine Foundation", Tata McGraw-Hill

Reference Books:

- IS-4326, "Code of Practice for earthquake resistant design and construction of building". BIS, New Delhi
- Craighead H, "High rise security and fire life safety", Butterworth-Heinemann
- Tony B, "Construction technology and choice", Wiley-Blackwell, U.K.

Focus: This course focuses on employability aligned with CO2 and CO5

Outcome: After completion of course, the student will be able to:

CO1: To Understanding the different types of high rise building and special structures
CO2: To Illustrate the different structural system
CO3: To understand the factors that causes the economy and optimization of the structural design and construction of high-rise building
CO4: To introduce the fundamental concepts relevant to different approach of high-rise building Construction
CO5: Classify sequence of activities involved in the construction of the high-rise structures.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO4, PO5, PO6, PO9/PSO1

CO2	PO1, PO2, PO10/PSO1, PSO2
CO3	PO1, PO2, PO3, PO5, PO7/PSO2
CO4	PO5, PO7/PSO2
CO5	PO1, PO5, PO4 /PSO2

MCMC 0081: REPAIR, RETROFITTING AND MAINTENANCE OF STRUCTURE

Objective: *This course provides a comprehensive knowledge of various distress and damages to concrete and masonry structures, importance of maintenance of structures, various types and properties of repair materials, damage to structures using various tests, importance and methods of substrate preparation and repair techniques of damaged, corroded structures.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Maintenance, rehabilitation, repair, retrofit and strengthening, need for rehabilitation of structures. cracks in R.C. buildings. Various cracks in R.C. buildings, causes and effects. Maintenance, importance of maintenance, routine and preventive maintenance. Damages to masonry structures. Various damages to masonry structures and causes. Repair materials: Various repair materials, criteria for material selection, methodology of selection, health and safety precautions for handling and applications of repair materials. Polymer Concrete and Mortar,. Bonding agents' Latex emulsions, Epoxy bonding agents. Protective coatings for Concrete and Steel FRP sheets	15
II	Damage diagnosis and assessment, Visual inspection, Non-Destructive Testing using Rebound hammer, ultra-sonic pulse velocity, semi destructive testing, Probe test, Pull out test, Chloride penetration test, Carbonation, Carbonation depth testing, Corrosion activity measurement,. Autogenous healing, Overlays, Repair to active cracks, Repair to dormant cracks. Corrosion of embedded steel in concrete, Mechanism, Stages of corrosion damage, Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing, Column jacketing, Beam jacketing, Beam Column joint jacketing, Reinforced, concrete jacketing, Steel jacketing, FRP jacketing.	15

Reference Books:

- Champion. S, "Failures and repair of concrete structures " , John Wiley and Sons, 1961.
- Raikar, R.N. "Diagnosis and treatment of structures in distress" Structwel Designers & Consultants, R & D Centre, 1994
- Handbook on "repair and rehabilitation of RCC buildings", CPWD, Government of India.
- Chakrabarti A. ,"Handbook on seismic retrofit of buildings", Narosa Publishing House, 2010.

Focus: This course focuses on employability aligned with all COs

Outcome: After completion of course, the student will be able to:

- CO1: Understanding maintenance, rehabilitation, repair, retrofit and their provisions.
- CO2: Illustrate importance of maintenance, damages to masonry structures, various repair materials and criteria for material selection.
- CO3: Enumerate various types of grouts and concrete, protective coatings for Concrete and Steel FRP sheets as a material of repair for specific purposes.
- CO4: Identify damage diagnosis and assessment, Non-Destructive Testing, semi destructive testing in order to inspect a structure.
- CO5: Describe crack repair, corrosion of embedded steel in concrete, jacketing and strengthening for shear and flexure.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2/PSO2
CO2	PO3,PO5/PSO2
CO3	PO2,PO5/PSO2
CO4	PO2,PO5,PO11/PSO2
CO5	PO3,PO5/PSO2

MCME 0101: GREEN BUILDING

Objective: *The objective of this course is to enable the learners to learn the principles of planning and orientation of buildings and to acquire knowledge on various aspects of green buildings.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction of green building, Concept of green building, History of green building, Need of green building in present scenario, Importance of green building merits and demerits, Classification of green building, Assessment methods LEED India, GRIHA (Green Rating for Integrated Habitat Assessment), IGBC (Indian Green Building Council) **Principles and elements for design of green building:** Sustainability concept and reality, Climate responsive process of design: Climatic zones, design sequence, shelter or form, landforms, vegetation, water bodies, street widths, open spaces, ground character, plan form, orientation, roof form, Shading devices and their effect.	15
II	**Thermal comfort inside the building:** Factors affecting thermal comfort, indices, cooling and heating requirement, Heat transmission through building sections, thermal performance of building sections, Day lighting, Ventilation. **Water conservation:** 3 R's for water conservation, rain water harvesting, low flow fixtures, grey water recycling. **Material conservation:** Concept of embodied energy, low energy materials, sustainable materials, alternative materials Concept of carbon emission and its reduction.	15

Text Books:

- Seetharaman S., “Construction Engineering and Management”, Umesh Publications, 2005.
- W.Tom and K, Sam , “Green Building Hand Book”, Taylor & Francis Group 2009

Reference Books:

- Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

Focus: This course focuses on employability aligned with CO2 and CO1

Outcome: After completion of course, the student will be able to:

- CO1: Understand the concept, importance and necessity of green building.
- CO2: Describe various assessment methods for green buildings.
- CO3: Explain the principles and elements for design of green building.
- CO4: Enumerate various factors affecting the thermal comfort inside the buildings..
- CO5: Classify various water conservation and material conservation techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO4/PSO1

CO3	PO2,PO5/PSO1
CO4	PO1/PSO1
CO5	PO1,PO2/PSO1

MCME 0111: ARBITRATION, CONTRACTS AND CLAIMS MANAGEMENT

Objective: *This is a foundation course to learn basic principles of Construction contracts, Claims & Arbitration in the context of various construction aspects.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	**Arbitration:** Comparison of Actions and Laws, Agreements, subject matter Violations-Appointment of Arbitrators-Conditions of Arbitrations, Powers and duties of Arbitrator-Rules of Evidence-Enforcement of Award-costs. Causes and resolution of disputes, settlement of claims and extra items, arbitration Indian Contract Act, Arbitration Act **Construction Contract Documents:** Evaluation of contract documents, need for documents, present stage of national and international contract documents, types of construction contracts, roles and functions of parties to the contract.	15
II	**Stages in Contracting:** Preparation of tender documents estimating, pre-qualification, bid evaluation, award of contract, project financing and contract payments, contracts close out and completion. **Contract Conditions:** Interpretation by parties to contract, obligations and responsibilities of the parties, protection and indemnification, bonds and insurance, laws and liens, subsurface conditions, inspection of work, change of work, rejected work and deficiencies. **Claims Management:** Raising and defending claims, Raising and defending claims	15

Reference Books:

- Prakash V. A., "Contracts Management in Civil Engineering Projects", NICMAR, 1997
- Patil B. S., "Civil Engineering Contracts and Estimates", University Press, 2009
- Vasavada B. J., "Engineering Contracts and Arbitration", (Self Publication by Jyoti B.Vasavada). 1997
- Albett Robert W., "Engineering Contracts and Specifications", John Willey and Sons, New York. 1961

Focus: This course focuses on employability aligned with CO2 and CO1

Outcome: After completion of course, the student will be able to:

- CO1: Understand various aspects of Arbitration to resolution of disputes in construction projects
- CO2: Develop concepts related with Construction contracts
- CO3: Understand the co-relation of client, consultant and contractor for the construction project with practical aspects
- CO4: Understand special aspect of tender & contract management.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO7,PO2/PSO2
CO2	PO1,PO7/PSO2
CO3	PO3,PO7/PSO2
CO4	PO1,PO7 /PSO2

MCME 0101: BUSINESS AND PROJECT COMMUNICATION

Objective: *The main objectives of this course are to equip students with the basics of communication at workplace, and the techniques of effective project communication management for handling variety of complex projects, and make them aware of the role of communication in the core project processes.*

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	Communication at workplace: Understanding Corporate communication, Objectives and Role of Communication, Process of Communication, Channels and Types of Communication, Communication Network, The C's of Good Communication. Verbal communication: Introduction, Oral and Written communication- letter writing and report writing. Business Presentations: Elements of Business Presentation and designing a Presentation, Effective listening, and Technology Enabled Communication Creative business Meetings: Techniques to conduct different types of business meetings. Group Communication: Media Management (Press Release, Press Report, Press Conferences, Public Speaking)	15
II	Role of project communications management in CRIP sector, Linking projects and strategy through effective communications, Preparing project leadership, Identifying and managing stakeholders, Project communication management processes- developing a communications plan, information distribution, performance reporting, administrative closure, establishing effective communication, Communicating with the internal and external stakeholders, effective organizational communication, managing diverse teams, managing project conflicts, overcoming resistance to change, project reporting tools and techniques	15

Text Books:

- M. Campbell, "Communication skills for project managers": Prentice Hall of India, 2010.

Reference Books:

- S. Jha, "The project manager's communication toolkit", CRC Press, 2010.

Focus: This course focuses on employability aligned with CO2 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Define the concept and issues in corporate communication
- CO2: To understand best practices in handling business meetings and presentations
- CO3: Identify and apply the practices of group communication and media management
- CO4: To understand the dimensions of project communication
- CO5: To develop the project communication management process
- CO6: Demonstrate competence in development and problem-solving in the area of team management

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO9/PSO3
CO2	PO1, PO5, PO8, PO9/PSO3
CO3	PO1, PO2, PO3, PO6, PO8 /PSO3
CO4	PO6, PO7, PO8, PO9, PO10, PO11/PSO3
CO5	PO6, PO8/PSO3
CO6	PO2, PO3/PSO3

MCME0031: MANAGEMENT of PUBLIC PRIVATE PARTNERSHIP

Objective: *Public Private Partnership is a blended learning programme designed to nurture certain basic level of Knowledge amongst individuals, working on PPPs or those interested in learning about PPPs, regardless of discipline or sector. The programme assists in preparing participants with the conceptual knowledge and skills to understand the Public Private Partnership as project. With focus on both theory and practice, the curriculum encompasses topics related to the designing a PPP transaction, financing options available, bidding for PPP, PPP contract management and dispute resolution. It also includes extensive regional and sectoral knowledge and comprises PPP best practices in India and around the world.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Background of public-private partnerships (PPPs) -** Economic environment and changes, economic and other reasons and compulsions for privatization; Private sector participation. **Different forms of PPPs -** contracting models (service contracts, maintenance contracts and management contracts); **Concession models -** (DBF, DBFO, DPBF, BOT, BOO, BOOT and variants of BOT models); **Financing models -** (PFI, SPV and other structures)	15
II	Government and multilateral agency guidelines, implementation principles; Enabling framework and model concessionaire agreements; Role of partners Structuring PPP projects to suit various sectors of infrastructure development, engineering and development projects; Risk management in PPPs Financing methodologies; Legal and contracting framework of PPPs; Process management; Drivers of success/failure of PPPs; Case studies.	15

Reference Books:

- Akimoye, A. Book, M , "PPP – Managing risks and opportunities",John Wiley & Sons, New York .2003.
- Akimoye, A. Book, M , "Policy. Finance and management for public private partnership". Blackwell, UK. 2009.
- Joshi, P. "Laws relating to infrastructure projects, Lexisnexis butterworths", New Delhi. 2003.
- Nair, P. Kumar, D. "Public Private Partnership in infrastructure: Issues & Perspective" ICFAI University press, Hyderabad, 2006.

Focus: This course focuses on employability aligned with CO5 and CO4
Outcome: After completion of course, the student will be able to:

- CO1: To identify the critical success factors for scoping and evaluating public infrastructure requiring private sector involvement.
- CO2: To acquire techniques for managing the political, technical & legal environment in which such projects are conceptualized and developed.
- CO3: To achieve value for money in the provision of infrastructure and public services.
- CO4: To understand project financing requirements and evaluate PPP financial models for both affordability and bankability.
- CO5: To understand environmental & social impact mitigation techniques to structure sustainable private investments in public infrastructure.
- CO6: To understand how government make Plans for managing sustainable PPP contracts including.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO3
CO2	PO2/PSO3
CO3	PO2/PSO3
CO4	PO1/PSO3
CO5	PO2/PSO3
CO6	PO4/PSO3

MCME 0110: E-BUSINESS FOR CONSTRUCTION

Objective: *To review the various fundamentals of e-business, improve work flow processes. Specifically studied will be the benefits of e-business and collaboration systems that function through the internet and allow a company to communicate with various team members more efficiently.*

Credits: 3 **L-T-P: 3-0-0**

Module No.	Contents	Teaching Hours
I	Fundamentals of e-Business, e-Business: The Construction, Organizational Readiness for e-Business, Integrated Multi-Disciplinary E-Commerce Infrastructure Framework, The Role of Extranets in Construction e-Business, Agent-based e-Commerce, The Role of e-Hubs in e-Business	15
II	Web Services, L-based e-Commerce for Construction Products Procurement, Next Generation Web Technologies for e-Commerce, Trust in e-Commerce, Legal Issues in e-Commerce, Knowledge Management for Improved e-Business Performance, e-Business in Indian Construction	15

Reference Books:

- J. Anumba. Chimay, Ruikar. Kirti, “e-Business in Construction”, Blackwell Publishing Ltd, 2008.
- Chaffey. D, “E-Business and E-Commerce Management”, Prentice Hall, 2014.
- D. Samson, “E-Business: Value creation for management”, The McGraw Hill Pub., 2003.

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

CO1: Understanding fundamentals of e-business.
CO2: Illustrate Integrated Multi-Disciplinary E-Commerce Infrastructure Framework.
CO3: Enumerate the Role of e-Hubs in e-Business and Web Services.
CO4: Identify Next Generation Web Technologies for e-Commerce.
CO5: Describe Knowledge Management for Improved e-Business Performance, e-Business in Indian Construction.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2/PSO3
CO2	PO2,PO4,PO7/PSO3
CO3	PO8,PO11/PSO3
CO4	PO7,PO8/PSO3
CO5	PO8,PO9/PSO3

COURSE STRUCTURE

Bachelor of Technology

Civil Engineering

Under

Choice Based Credit System (CBCS)

Open Electives

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P				
THEORY									
1	BCEO 0003	Finite Element Analysis	3	1	0	4	4		
2	BCEO 0004	Industrial pollution control And Environmental Audit	4	0	0	4	4		
3	BCEO 0005	Environmental Impact Assessment	4	0	0	4	4		
4	BCEO 0006	Solid and Hazardous waste Management	4	0	0	4	4		
5	BCEO 0007	Environmental Sustainable Technologies	4	0	0	4	4		
6	BCEO 0008	Air and Noise Pollution Control	4	0	0	4	4		
PRACTICALS									

BCEO 0003: FINITE ELEMENT METHODS

Objective:

- *To provide the fundamental concepts of the theory of the finite element method*
- *To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general –purpose finite element code.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Finite Element Analysis:** Introduction Basic Concepts of Finite Element Analysis Introduction to Elasticity Steps in Finite Element Analysis **Finite Element Formulation Techniques**: Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions **Element Properties:** Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Iso parametric Formulation, Stiffness Matrix of Iso parametric Elements, Numerical Integration: One Dimensional. Numerical Integration: Two and Three Dimensional	20
II	**Analysis of Frame Structures:** Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame **FEM for Two and Three Dimensional Solids:** Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axi symmetric Element, Finite Element Formulation of Axi symmetric Element, Finite Element Formulation for 3 Dimensional Elements	20

Text Books:

- O.C. Zienkiewicz Finite Element Method for Engineers and scientists – (2013).
- K.J. Bathe & E.L. Wilson Numerical Methods in Finite Element Analysis – (2014).

Reference Books:

- Alan Jennings Matrix Computations for Engineers & scientists – (1977).
- C.S. Desai & J.F. Abel Introduction to Finite Element Method – (2001).
- S.S. Rao Finite Element Method in Engineering – (2011)

Focus: This course focuses on employability aligned with CO1 and CO4

Outcomes: On completion of this course the student will be able to

- CO1: To understand of the fundamental theory of the FEA method
- CO2: To describe the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements; to understand the application and use of the FE method for heat transfer problems.
- CO3: To demonstrate the ability to create models for trusses, frames, plate structures, machine parts, and components using ANSYS
- CO4: To demonstrate the ability to evaluate and interpret FEA analysis results for design and evaluation purposes
- CO5: To develop the ability to generate the governing FE equations for systems governed by partial differential equations
- CO6: To develop a basic understanding of the limitations of the FE method and understand the possible errors our cesinits use.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	PO1, PO2
CO2	PO1, PO2
CO3	PO1, PO2
CO4	PO1, PO2
CO5	PO1, PO2
CO6	PO1, PO2

BCEO 0004: INDUSTRIAL POLLUTION CONTROL AND ENVIRONMENTAL AUDIT

Objective: *Learn the process of pollution control from various processed industries*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Industrial Wastes and Their Sources, Various Industrial Processes, Water Quality for Industrial Water Usages. **Processes Responsible for Deterioration in Water Quality:** Control and Removal of Specific Pollutants in Industrial Wastewaters Like Oil and Grease, Bio-Degradable Organics, Chemicals Such as Cyanide, Fluoride, Toxic Organics, Heavy Metals, Wastewater Re-Uses and Recycling.	20
II	**Control of Gaseous Emissions**: Particulate and Gaseous Pollutant Control, Solid Waste Generation and Disposal Management, Hazardous Wastes: Definitions, Concepts, and Management Aspects, Noise and Radiation: Generation, Control, and Management. **Recent Trends in Industrial Waste Management:** Life Cycle Analysis, Case Studies of Various Industries- Dairy, Fertilizer, Distillery, Sugar, Pulp and Paper, Iron and Steel, Metal Plating, Thermal Power Plants, **Environmental Audit**: Environmental Impact Assessment, Definitions and Concepts, Various Pollution Regulations, Introduction to ISO and ISO 14000.	20

Text Books:

- S.H. Azad, "Industrial Wastewater Management Handbook" USA: McGraw Hill, New York; 1976.
- A.K. Chatterjee "Water Supply, Waste Disposal and Environmental Pollution Engineering", New Delhi: Khanna Publishers; 2001.
- G.L Culp, "Wastewater Reuse and Recycling Technology-Pollution Technology Review" New York USA: Mountain view Books; 1980

Reference Books:

- B. Edmund, and P.E. Besselieve, "*The Treatment of Industrial Wastes*" New York USA: McGraw Hill; 1962.
- Environment (Protection) Act. "*Ministry of Environment*" New Delhi: Government of India; 1986.
- Metcalf and Eddy "*Wastewater Engineering:* Treatment and Re-use" New York USA: McGraw-Hill; 2011.
- G.N. Pandey, and G.C Corney "*Environmental Engineering*" New Delhi: Tata McGraw Hill; 1993.
- H. Peavy, H.D. Rowe, "*Environmental Engineering"* New York USA: McGraw Hills; 1985.
- N.J Sell,. "*Industrial Pollution Control: Issues and Techniques*" New York, USA: John Willy and Sons; 1992.

Outcome: After completion of course, the student will be able to:

- CO1: Learn the basics of Industrial Pollution sources and its characteristics
- CO2: Depict the information about various Industrial effluent treatment processes
- CO3: Understand various disposal standards for industrial effluents
- CO4: Analyses Environmental audit process
- CO5: Learn the process of pollution generation from various processed industries
- CO6: Understand basics of Environmental Standard

BCEO 0005 ENVIRONMENTAL IMPACT ASSESSMENT

Objective: *To understand Environmental Impact of different industrial and development activities*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	Environmental impact assessment (EIA), definitions and concepts, rationale and environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status historical development of EIA, EIA in Civil Engineering, Initial environmental examination, environmental impact statement, environmental appraisal, of EIA in India. Environmental audit, definitions and concepts, partial audit, compliance audit, methodologies and regulations; introduction to ISO and ISO 14000	20
II	Environmental management - principles, problems and strategies; Review of political, ecological and remedial actions; future strategies; multidisciplinary environmental strategies, the human, planning, decision-making and management dimensions. Life cycle assessment; Triple bottom line approach; Industrial Ecology; Ecological foot printing; Carbon trading; Sustainable development	20

Text Books:

- S.K. Shukla and P.R Srivastava,., "Concepts in Environmental Impact Analysis", New Delhi: Common Wealth Publishers; 1992.
- G.J. Rau and C.D. Wooten, Environmental Impact Analysis Handbook, New York: McGraw Hill; 1980

Reference Books:

- R.L Canter. "Environmental Impact Assessment" New Delhi: McGraw Hill Inc.; 1996.

Focus: This course focuses on employability aligned with CO1 and CO2

Outcome: After completion of course, the student will be able to:

- CO1:Learn the basics relationship of Environment Impact Analysis
- CO2: Understand the Different Environmental Management Plan
- CO3: Learn different aspects of Environmental Audit
- CO:4 Understand the concept of Ecological Foot Print and Carbon Trading

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2
CO2	PO1, PO2
CO3	PO1, PO2
CO4	PO1, PO2

BCEO 0006: SOLID AND HAZARDOUS WASTE MANAGEMENT

Objective: *Template Understand the management of solid and hazardous waste*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Solid and Hazardous Waste Management**: Municipal solid waste management: sources, nature and characteristics; quantitative and qualitative; Solid waste problems: Industrial, mining, refineries and petrochemical plants, agricultural and domestic (urban) wastes. Hydrologic aspects of solid waste. Regulatory aspects of solid waste management. **Solid waste disposal:** Sanitary landfill planning, site selection, design and operation, equipment, costs, landfill stabilization. Biological oxidation. Composting, optimum conditions for composting. Pyrolysis; Incineration - waste characterization, combustion calculation, unit operations, supply of air, furnace temperature, waste reduction and environmental control. Plastic waste management. Fly ash- Generation and management	20
II	**Biomedical waste** categorization, generation, collection, transport, treatment and disposal. Hazardous waste landmark episodes, classification, generation. Guidelines for HWM. Regulatory framework in the USA, EU and India, Basal convention. **Treatment and disposal; remediation of contaminated sites**. Reclamation and ecological restoration of degraded land: Physical reclamation: Top soil management- inventory, removal, transportation, preservation and redistribution; monitoring of top soil quality, estimation of soil erosion, sediment load and design of sedimentation pond. Soil amendment, mulches and coir mats; principles of ecological restoration, SERI guidelines; factors affecting plant establishment.	20

Text Books:

- N.J Sell. *Industrial Pollution Control Issues and Techniques* New York, USA: John Willy and Sons; 1992
- Subodh Kumar Maiti, *Eco restoration of the coalmine degraded lands* Springer; 2013.

Reference Books:

- MD Lagrega, PL Buchingham and JC Evans *Hazardous Waste Management* 2nd NY: McGraw Hill; 2001.
- JB Eweis, SJ Ergas, DYP Chang and ED Schroeder *Bioremediation Principles* Singapore: McGraw-Hill; 1998.

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Learn the basics of Solid & Hazardous waste Management
- CO2: Understand the process of solid waste generation
- CO3: Depict the information about various methods of Solid waste collection
- CO4: Learn basics of Monitoring and aftercare of restored site
- CO5: Analyses the various safe and secure method of hazardous waste disposal
- CO6: Learn various soil pollution remedial methods

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2
CO2	PO1, PO2
CO3	PO1, PO2
CO4	PO1, PO2
CO5	PO1, PO2
CO6	PO1, PO2

BCEO 0007: ENVIRONMENTAL SUSTAINABLE TECHNOLOGIES

Objective: *To Learn different technology of sustainable environment*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Energy Systems and Environment:** Environmental effects of energy extraction, conversion and use; sources of pollution from energy technologies (both renewable and non-renewable); primary and secondary pollutants; consequence of pollution and population growth; air, water, soil, thermal, noise pollution -cause and effect; pollution control methods, sources and impacts; environmental laws on pollution control. Kyoto Protocol; Conference of Parties (COP); Clean Development Mechanism (CDM); Reducing Emissions from Deforestation and Degradation (REDD). **Biomass and its properties** relevant for conversion technology, Bio-energy conversion technologies – Thermo chemical and Biological. Energy conversion devices	28
II	**Concept of sustainable development:** The inseparable linkages of life supporting systems, biodiversity and ecosystem services and their implications for sustainable development; global warming; greenhouse gas emissions, impacts, mitigation and adaptation; future energy Systems- clean/green energy technologies; International agreements/conventions on energy and sustainability - United Nations Framework Convention on Climate Change (UNFCC); sustainable development. Clean City initiatives .Concept of Green Buildings, need for community participation in sustainable development.	28

Text Books:

- Sell N.J. Industrial Pollution Control –Issues and Techniques New York, USA: John Willy and Sons; 1992
- Rau, G.J. and Wooten, C.D., Environmental Impact Analysis Handbook, New York: McGraw Hill; 1980.
- Canter L. Environmental Impact Assessment, New York: McGraw Hill; 1996.
- Garg S.K. *Water Supply Engineering (Environmental Engineering Vol.-I)* New Delhi: Khanna Publisher; 2008.
- Garg S.K. *Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol.-II)* New Delhi: Khanna Publishers; 2008

Reference Books:

- Davis M. L. and Cornwell D. A. "*Introduction to Environmental Engineering*", 4th Edition, Boston: McGraw-Hill; 2008.

Focus: This course focuses on employability aligned with CO6 and CO2

Outcome: After completion of course, the student will be able to:

- CO1: Learn the basics relationship of energy and Environment
- CO2: Understand the Different energy conversion technologies
- CO3: Learn different aspects of sustainable development
- CO4: Understand key current environmental problems
- CO5: understand the concept of Clean Development Mechanism
- CO6: Analyse the benefits of natural resources use in sustainable manner

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2
CO2	PO1, PO2
CO3	PO1, PO2
CO4	PO1, PO2
CO5	PO1, PO2
CO6	PO1, PO2

BCEO 0008: AIR AND NOISE POLLUTION CONTROL

Objective: *To understand concept of air and Noise Pollution and its control*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Air Pollutants and their Effects**: Sources of air pollution, Atmospheric meteorology, Gases and particulate Sinks, transport; Effects of health and environment; ambient and source standards. **Aerosols:** Characterization of aerosols, size distributions, measurement methods; **Transport behavior**: diffusion, sedimentation, Radiation properties – visibility, climate effects; principles of particulate control systems	20
II	**Gaseous Pollutants:** Diffusion and Interfacial mass-transfer; Control systems. Air quality management: dispersion modeling, source apportionment methods. **Noise Pollution:** Basics of acoustics and specification of sound, sound intensity and sound pressure levels; outdoor and indoor noise propagation; psycho-acoustics and noise criteria, effects of noise on health, special noise environments: Infra-sound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices.	20

Text Books:
- A. P. Sincero and G A Sincero Environmental Engineering New Delhi: Prentice Hall of India; 1999
- C. S. Rao Environmental Pollution Control Engineering New Delhi: Wiley Eastern Ltd; 1996

Reference Books:
- E. Cunniff *Environmental Noise Pollution* New York: McGraw Hill; 1987
- H. Brauer and Y. B. G. Verma *Air Pollution Control Equipment* New York: Berlin Heidelberg; 1981

Focus: This course focuses on employability aligned with CO5 and CO6
Outcome: After completion of course, the student will be able to:

- CO1: Learn the basics of Air composition and its characteristics
- CO2: Understand about various properties of Aerosols, Gaseous and Particulate matter of Air
- CO3: Identify the sources of air and noise pollution
- CO4: Understand the concepts involved in control technologies of air and Noise pollution control
- CO5: Depict the knowledge about various air pollution control devices
- CO6: Understand the transport behavior of air pollutants

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2
CO2	PO1, PO2
CO3	PO1, PO2
CO4	PO1, PO2

CO5	PO1, PO2
CO6	PO1, PO2

COURSE STRUCTURE

PH.D.

CIVIL ENGINEERING

Under

Choice Based Credit System (CBCS)

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	PCEC 0002	Advanced Concrete Technology	4	0	0	4	4
2	PCEC 0001	Non Conventional Construction Materials & elements	4	0	0	4	4
3	PCEC 0003	Retrofitting of Structures	4	0	0	4	4
4	PCEC 0004	Numerical Methods and Applied Statistics	4	0	0	4	4
5	PTEC 0002	Numerical Methods and Applied Statistics	4	0	0	4	4
6	PCEC 0005	Environmental Impact and Risk Assessment	4	0	0	4	4
7	PTEC 0001	Pavement Analysis and Design	4	0	0	4	4
8	PREC 0001	Research Methodology	4	0	0	4	4
9	PMG 1001	Research Methodology	4	0	0	4	4
10	PREC 0010	Research and Publication Ethics	4	0	0	4	4

PCEC 0002: ADVANCED CONCRETE TECHNOLOGY

Objective: *This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high quality concrete for buildings and Infrastructure*

Credits: 04 **L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	**Cement production, composition and cement chemistry:** Importance of Bogue's compounds, Structure of a Hydrated Cement Paste, Volume of hydrated product, porosity of paste and concrete, transition Zone, Elastic Modulus, factors affecting strength and elasticity of concrete **Aggregates for concrete:** Review of types and classification; chemical composition; origin and manufacture; actions and interactions; usage; effects on properties of concretes **Chemical admixtures**: Mechanism of chemical admixture, Plasticizers and super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh cone test for optimum dosage of super plasticizer, retarder, accelerator, Air-entraining admixtures, new generation superplasticizer. **Mineral admixtures:** Fly ash, Silica fume, GCBS, and their effect on concrete property in fresh state and hardened state.	20
II	**Fresh concrete:** Rheology of concentrated suspensions, pastes, mortars and concretes; workability, segregation and bleeding. Theory and principles governing the correct placing and compaction of concrete. **Properties of hardened concrete:** Plastic settlement and plastic shrinkage; exothermic characteristics; early age thermal movements; strength development; maturity, accelerated curing Strength; deformation under load; elasticity; creep; drying shrinkage and other volume changes. Thermal properties. **Durability of concrete:** Durability concept; pore structure and transport processes; reinforcement corrosion; fire resistance; frost damage; sulfate attack; alkali silica reaction; delayed Ettringite formation; methods of providing durable concrete; short-term tests to assess long-term behaviour.	20

Reference Books:

- M. Neville, Properties of Concrete, Pearson education (2012).
- Performance Criteria for Concrete Durability, E & F N Spon, London.- J. Kroop and H.K.Hilsdorf(2004).
- Concrete Construction Engineering Hand Book, CRC Press, New York.- Edward G Nawy (2008).
- Concrete Technology, theory and Practice, S.Chand- M. S. Shetty(2000)
- Concrete Technology, Theory and Practice, McGraw Hill.- M. L. Gambhir(2013)
- Concrete, Tata Mc Graw Hill.,- P.K.Mehta & Paulo J.M.Monterio (2005)
- Advances in Cement Technology, Tech Book International, New Delhi.-S.N.Ghosh (2006).

Focus: This course focuses on employability aligned with CO3 and CO4

Course Outcomes:

- Understand the structure and properties of concrete making materials
- Discuss the concrete ingredients and its influence at gaining strength.
- Understand the durability requirements of fresh concrete
- Identify Quality Control tests hardened concrete

- Design concrete mixes as per IS codes

PCEC 0001: NON-CONVENTIONAL CONSTRUCTION MATERIALS & ELEMENTS

Objective: This course provides knowledge on the application and uses of various different types of concrete which results in production and construction of high quality concrete for buildings and infrastructure

Credits: 04 **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	**Ferro cement:** Introduction to Ferro cement design principals, materials used, manufacture of Ferro cement elements, Type of members commonly used, use of Ferro cement in rehabilitation of Structures. **Fiber reinforced concrete:** Various types of fibers like glass, steel, asbestos etc. Physical & Mechanical Properties, Use of Fiber Reinforced Concrete in structural elements.	19
II	**Light weight concrete:** Various types of light weight aggregate, physical and mechanical properties. Introduction to structural plastics and similar elements. Smart materials, Environment friendly materials **Polymers and Polymer Concrete:** Physical and mechanical properties and its use in Civil Engineering. Introduction to Bamboo in Civil Construction, Cementitious composite reinforced with vegetable and hybrid fibers, Construction with Earth	21

Reference Books:

- A. M. Neville, Properties of Concrete, Pearson education (2012).
- Concrete for High Temperature, Maclaren and sons, London- A. Petzold & M.Rohrs (1970).
- Advances in Cement Technology, Tech Book International, New Delhi.- S.N. Ghosh (2006).
- Concrete, Tata Mc Graw Hill.,- P.K.Mehta & Paulo J.M.Monterio(2005)

Focus: This course focuses on employability aligned with CO1

Course Outcomes:

- Understand the application and use of Ferro cement
- Describe the application and use of Fiber reinforced concrete
- Describe the application and use of Light weight concrete
- Understand the application and use of Polymers and Polymer Concrete
- Understand the application and use of Construction with Earth

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PCEC 0003: RETROFITTING OF STRUCTURES

Objective: The objective of this course is to develop knowledge about various mechanisms of deterioration of reinforced and plain concrete, its estimate and rehabilitation

Credits: 04 **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Durability of concrete: Factors affecting durability of concrete, Corrosion of reinforcements in concrete, Carbonation, Chloride ingress, Alkali-silica reaction, Freeze-thaw effects, Chemical attack, Abrasion, erosion and cavitation, Weathering and efflorescence Defects and deterioration in buildings, Survey and assessment of structural conditions in RCC structures. Damage/condition assessment and various methods (for quantification) for its evaluation, Rapid Visual Screening (RVS) and ways to do RVS of damaged/deteriorated structures, Overview of health monitoring techniques.	20
II	Non-destructive testing of concrete quality, Non-destructive testing of connections in steel, Corrosion assessment in reinforcements in RCC elements and components in steel structures; Design principles, techniques and working mechanism various instruments used for NDT evaluations (for strength, durability etc.) like Rebound Hammer, UPV, impact echo etc.; Technology used in various advanced instruments like Imaging techniques, GPR, Thermography, Tomography etc. Materials for repairs, rehabilitation and retrofitting processes, Methods for repairs, rehabilitation and retrofitting including surface preparation, Study of failures of buildings and lesson learnt, Role of quality control in construction as Preventive measures Maintenance of buildings.	20

Reference Books:

- Technology of Building Repairs, Raikar R N
- The Bombay Building Repairs & Reconstruction Board Act 1969, Govt. of Maharashtra
- Maintenance & Repairs of Buildings, P. K. Guha
- Concrete Structures Protection Repair and Rehabilitation, R. Dodge Woodson, Elsevier Publication
- Construction, Maintenance & Restoration and Rehabilitation of Highway Bridges, K. S. Rakshit
- Retrofitting of Concrete Structures by Externally Bonded FRP‘s – CEB – FIP, Technical report,

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Detect defects and deterioration in buildings.
- CO2: Assessment of structural conditions in R.C.C. structures.
- CO3: Understand and apply rehabilitation and retrofitting process and their field applications
- CO4:Analyze non-destructive testing methods and their field applications
- CO5: Interpretation of the results for concrete and steel structures.

PCEC0004: NUMERICAL METHODS AND APPLIED STATISTICS

Objective: *To provides the tools and techniques for data collection and analysis.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
01	**Sampling Theory**: Population Parameter, Sample Statistics, Sampling distributions, Sample mean, Sampling distribution of means, the sample variance, the sampling distribution of variance. **Estimation Theory:** Point estimate and interval estimates, reliability, confidence interval estimates of population parameters, confidence intervals for means, proportions and variance. **Tests of Hypothesis and Significance:** Statistical decisions, tests of hypotheses and significance, Type I and Type II errors, level of significance, one tailed and two tailed tests. Tests involving small samples and large samples, fitting theoretical distributions to sample frequency distribution, The chi, square test for goodness of fit. **Linear Programming:** Formulation of linear programming problem, Graphical solution, simplex method	20
02	**Introduction**, roots of a non-linear equation and roots of a polynomial of nth degree [incremental search method, method of successive approximations, Newton's method, bisection method, secant method, Müller's method, synthetic division, Bairstow's method] and convergence study Solution of (non-homogeneous) linear algebraic equations, review of matrix algebra, Gauss elimination method, Cholesky's decomposition method, householder method, Gauss-Siedal iterative method 12 II **Solution of non-linear algebraic equations**, method of successive approximation, Newton's method, modified Newton – Raphson method, secant method Eigen values and Eigen vectors, reduction of generalized Eigen value problem to the standard Eigen value problem, methods for obtaining Eigen values and Eigen vectors [polynomial method, vector iteration method, Mises power method, Jacobi method]	20

Reference Books:

- M.R. Speigel, Probability and Statistics, McGraw Hill,
- C.R. Kothari, Research methodology: Methods and techniques. New Age International.
- H.A. Taha, Operation Research, Prentice Hall of India Pvt. Ltd.
- Miller and Freund, Probability and Statistics for Engineers.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, New Delhi.
- Chapra, S. C. and Canale R. P., "Numerical Methods for Engineers", Tata McGraw hill.
- Carnahan, B., Luther, H. A. and Wilkes, J. O., "Applied Numerical Methods", John Wiley.
- Douglas Faires, J. and Richard Burden, "Numerical Methods", Thomson.
- Rajasekaran, S., "Numerical Methods in Science and Engineering", S. Chand.

Focus: This course focuses on employability aligned with CO1, CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the concept of sampling theory and estimation theory
- CO2: Understand the concept of Hypothesis and testing of Hypothesis
- CO3: Analyze the polynomial of nth degree
- CO4: Understand the matrix algebra and solution of non-linear algebraic equations

PTEC0002: NUMERICAL METHODS AND APPLIED STATISTICS

Objective: *To provides the tools and techniques for data collection and analysis.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
01	**Sampling Theory**: Population Parameter, Sample Statistics, Sampling distributions, Sample mean, Sampling distribution of means, the sample variance, the sampling distribution of variance. **Estimation Theory:** Point estimate and interval estimates, reliability, confidence interval estimates of population parameters, confidence intervals for means, proportions and variance. **Tests of Hypothesis and Significance:** Statistical decisions, tests of hypotheses and significance, Type I and Type II errors, level of significance, one tailed and two tailed tests. Tests involving small samples and large samples, fitting theoretical distributions to sample frequency distribution, The chi, square test for goodness of fit.	20
02	**Linear Programming:** Formulation of linear programming problem, Graphical solution, simplex method (including Big M method and two phase method), dual problem, duality theory, dual simplex method, revised simplex method. **Transportation problem:** existence of solution,degeneracy, MODI method; Assignment problem, traveling salesman problem Nonlinear programming problem (NLPP): Constrained NLPP, Lagrange's multipliers method, convex NLPP, Kuhn,Tucker conditions	20

Reference Books:

- M.R. Speigel, Probability and Statistics, McGraw Hill,
- Kothari, C.R., 2004. Research methodology: Methods and techniques. New Age International.
- H.A. Taha, Operation Research, Prentice Hall of India Pvt. Ltd.
- Miller and Freund, Probability and Statistics for Engineers.
- J.C. Pant, Introduction to Optimisation : Operations Research, Jain Brothers, New Delhi.

Focus: This course focuses on employability aligned with CO1, and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Apply various sampling methods
- CO2: Understand problem of statistical inference, problem of point and interval estimation
- CO3: Understand hypothesis testing
- CO4: Analyze the various transportation problem

PCEC0005: ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

Objective: *Objective of this course is to identify, predict and evaluate the economic, environmental and social impact of development activities*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
01	Environmental impact assessment (EIA)- definitions and concepts, Evolution of EIA, Initial environmental examination, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, Post project monitoring, EIA report and environmental impact statement (EIS); Post project monitoring, Review process. Status of EIA in India; Case studies on project, regional and sectoral EIA	20
02	Environment Risk assessment: Introduction, Objectives, Risk assessment methodology, Pre and post mitigation risk assessment.	20

Reference Books:

- Canter, L. W., Environmental Impact Assessment, McGraw-Hill, 2 nd Ed., 1997.
- Agarwal, N. P., Environmental Reporting and Auditing, Raj Pub., 2002.
- J. G. Rau and D. C. Wooten, Environmental Impact Analysis Handbook, McGraw-Hill, 1980.
- C. H. Eccleston, Environment Impact Statements: A Comprehensive Guide to Project and Strategic Planning, John Wiley & Sons, 2000.

Focus: This course focuses on employability aligned with CO1, and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the concept of environmental impact assessment and its evolution
- CO2: Evaluate the impact of development activities on environment.
- CO3: Analyze the environment risk and its assessment
- CO4: Understand the pre and post mitigation risk assessment.

MTEC 0002: PAVEMENT ANALYSIS AND DESIGN

Objective: *To impart knowledge of pavement types and their functions, analysis and design of flexible and Rigid pavement based on recent IRC/AASHTO codes.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Pavements:** History of Pavements, Pavements types, Advantages and Disadvantages **Pavement Mix Analysis:** Aggregate blending, bituminous mix design, Marshall Stability approach, concrete mix design for roads. **Pavement Basics:** Types & comparison, vehicular loading pattern, loading pattern on airport pavement, factors affecting design and performance of pavements, airport pavement, environmental impact on pavements, sub grade requirements.	18
II	**Design of Flexible Pavements:** Analytical approach, flexible pavement layers, ESWL, repetitions of load, techniques of design methods, wheel load analysis, traffic analysis, stress distribution in subgrade soil, Burmister's theories, group index method, CBR approach, IRC guidelines, CRV method, triaxial & McLeod method, present practices, shoulder design. **Design of Concrete Pavements:** Westergaard's approach, temperature & frictional stresses, design of expansion & longitudinal joints, design of dowel & tie bars, IRC guidelines, present design practices.	22

Text Books:

- Yoder and Witezak, *Principles of Pavement Design,* John Wiley and sons
- Yang, *Design of functional pavements,* McGraw, Hill

Reference Books:

- IRC codes : 37, 58, 15 and other relevant codes

Focus: This course focuses on employability aligned with CO3 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Classify the pavement types and their properties.
- CO2: Explain mix design for flexible and rigid pavement.
- CO3: Understand the different loading patterns on different pavements.
- CO4: Design the flexible pavement using CBR method and IRC guidelines
- CO5: Learn about present practices for flexible pavement and shoulder design.
- CO6: Design the Rigid Pavement using Westergaard's approach and IRC guidelines.

COURSE STRUCTURE

B. TECH.
ELECTRICAL ENGINEERING

Under
Choice Based Credit System (CBCS)

Batch 2020-24

PROGRAM STRUCTURE
EE-1100

Sr. No.	Categorization	Credits
1	Humanities & Social Sciences	25
2	Basic Sciences	24
3	Engineering Sciences	28
4	Project Work / Seminars	17
5	Program Core	48
6	Program Electives	26
7	Open Electives	16
8	Non Graded Mandatory Courses	8(2 credits in each sem.)
	Total Credits	186/192(Including MNC)

Project Work / Seminars	Mini Project	4 = (1+3)
	Industrial Training	2
	Minor Project	3
	Major Project	8

SEMESTER I

SR. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	CONTACT HRS/WK
1.	BMAS0101	Engineering Mathematics – I	3	1	0	4	4
2.	BELH0001	English Language Skills For Communication I	1	2	0	2	3
3.	BPHS0001	Engineering Physics	3	1	0	4	4
4.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
5.	BEEG1001	Basic Electrical Engineering	3	1	0	4	4
		PRACTICALS					
6.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
7.	BMEG0801	Engineering Drawing	0	0	2	1	2
8.	BEEG0801	Electrical Simulation Lab	0	0	4	2	4
9.	BELH0801	English Language Lab I	0	0	2	1	2
10.	BMEG0801 /BMEG0800	Engineering Drawing/Workshop Practice Lab	0	0	2	1	2
11.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
		Total	**15**	**6**	**14**	**25**	**33**

SEMESTER II

SR. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	CONTACT HRS/WK
1.	**BMAS 0102**	Engineering Mathematics – II	2	0	0	4	2
2.	BELH 0002	English Language Skills For Communication – II	1	2	0	2	3
3.	BCHS 0101	Engineering Chemistry	3	1	0	4	3
4.	BCSC 0001	Computer Programming	3	2	0	5	4
5.	BECG 0001	Electronics Engineering	3	1	0	4	4
6.	BEEG 0002	Electrical Technology	3	0	0	3	3
		PRACTICALS					
7.	BEEG 0802	Electrical technology Lab	0	0	2	1	2
8.	BECG 0800	Electronics Lab – I	0	0	2	1	2
9.	BCSC 0800	Computer programming lab	0	0	2	1	4
10.	BELH 0802	English Language Lab – II	0	0	2	1	2
11.	BCHS 0801	Engineering Chemistry Lab	0	0	2	1	2
		TOTAL	15	1	10	27	34

Program Core
B. Tech. Electrical Engineering Courses

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/CO-REQUISITES
			L	T	P	J			
THEORY									
1.	BEEC0003	Engineering Circuit Analysis & Synthesis	3	0	0	0	3	3	-
2.	BEEC0004	Electrical Measurement & Measuring Instruments	3	0	0	0	3	3	-
3.	BEEC0005	Field Theory & Applications	3	0	0	0	3	3	-
4.	BEEC0006	Basic System Analysis	3	0	0	0	3	3	-
5.	BEEC0007	Analog Integrated Circuit	3	0	0	0	3	3	-
6.	BEEC0008	Digital Electronics & Circuits	3	0	0	0	3	3	-
7.	BEEC0009	Electrical Machines – I	3	0	0	0	3	3	
8.	BEEC0010	Electrical Machines – II	3	0	0	0	3	3	
9.	BEEC0011	Control System	3	0	0	0	3	3	
10.	BEEC0012	Elements Of Power System	3	0	0	0	3	3	
11.	BEEC0013	Power System Analysis	3	0	0	0	3	3	
12.	BEEC0014	Power Electronics	3	0	0	0	3	3	
13.	BEEC0015	Microprocessor & Its Applications	3	0	0	0	3	3	
PRACTICAL									
14.	BEEC0803	Network Lab	0	0	2	0	1	2	BEEC0003
15.	BEEC0804	Electrical Measurement Lab	0	0	2	0	1	2	BEEC0004
16.	BEEC0805	Analog & Digital Electronics Lab	0	0	2	0	1	2	BEEC0008
17.	BEEC0806	Electrical Machines Lab – I	0	0	2	0	1	2	BEEC0009
18.	BEEC0807	Electrical Machines Lab – II	0	0	2	0	1	2	BEEC0010
19.	BEEC0808	Control System Lab	0	0	2	0	1	2	BEEC0011
20.	BEEC0809	Power System Lab	0	0	2	0	1	2	BEEC0013
21.	BEEC0810	Power Electronics Lab	0	0	2	0	1	2	BEEC0014
22.	BEEC0811	Microprocessor Lab	0	0	2	0	1	2	BEEC0015
		Total	39	0	18	0	48	57	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Power System									
THEORY									
1.	BEEE0030	Electrical Power Generation	3	0	0	0	3	3	
2.	BEEE0036	Intelligent Techniques In Electrical Engineering	3	0	0	0	3	3	
3.	BEEE0037	Computer Methods in Power Systems	3	1	0	0	4	4	
4.	BEEE0031	High Voltage Engineering	4	0	0	0	4	4	
5.	BEEE0034	Power System Operation & Control	3	1	0	0	4	4	
6.	BEEE0032	Smart Grid	3	0	0	0	3	3	
7.	BEEE0038	Power System Dynamics & Stability	3	0	0	0	3	3	
PRACTICALS									
8.	BEEE0851	Intelligent Techniques In Electrical Engineering Lab	0	0	2	0	1	2	BEEE 0036
9.	BEEE0852	Computer Methods in Power Systems Lab	0	0	2	0	1	2	BEEE0037

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Instrumentation & Control									
THEORY									
1.	BEEE0050	Sensors & Transducers	3	0	0	0	3	3	
2.	BEEE0056	PLC & SCADA	3	0	0	0	3	3	
3.	BEEE0052	Advance Control System	3	0	0	0	3	3	CS
4.	BEEE0053	Biomedical Instrumentation	3	0	0	0	3	3	
5.	BEEE0054	Process Control & Advanced Instrumentation	4	0	0	0	4	4	EMMI & CS
6.	BEEE0055	Digital Control System	3	1	0	0	4	4	
7.	BEEE0051	Optimal Control System	3	0	0	0	3	3	CS
PRACTICALS									
8.	BEEE0860	Process Control & Advanced Instrumentation Lab	0	0	2	0	1	2	BEEE0054
9.	BEEE0861	PLC & SCADA Lab	0	0	2	0	1	2	BEEE0056
PROJECTS (IF EXIST)									
10.	BEEJ0961	PLC Based Project	0	0	0	4	1	4	BEEE0056

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Machine & Drives									
THEORY									
1.	BEEE0070	Electrical Engineering Materials	3	0	0	0	3	3	
2.	BEEE0072	Electric Drives	3	0	0	0	3	3	
3.	BEEE0071	Special electric Machines	3	0	0	0	3	3	
4.	BEEE0074	Computer Aided Electric Machine Design	3	0	0	0	3	3	
5.	BEEE0076	Electric Vehicles	3	1	0	0	4	4	
PRACTICALS									
6.	BEEE0870	Electric Drives Lab	0	0	2	0	1	2	BEEE0072
7.	BEEE0871	Computer Aided Electric Machine Design Lab	0	0	2	0	1	2	BEEE0074
PROJECTS									
8.	BEEJ0966	Electric Vehicles Project	0	0	0	8	2	8	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Energy Systems									
THEORY									
1.	BEEE0090	Introduction to Renewable Energy Technologies	3	0	0	0	3	3	
2.	BEEE0099	Design & Installation of Solar PV System	3	1	0	0	4	4	
3.	BEEE0100	Illumination Science & Engineering	3	1	0	0	4	4	
4.	BEEE0095	Solar Energy System	3	0	0	0	3	3	
5.	BEEE0094	Wind Energy Conversion System	3	0	0	0	3	3	
PRACTICALS									
6.	BEEE0881	Solar Energy System Lab	0	0	2	0	1	2	BEEE0095
7.	BEEE 0882	Design & Installation of Solar PV System Lab	0	0	2	0	1	2	BEEE 0099
PROJECTS (IF EXIST)									
8.	BEEJ0972	Design & Installation of Solar PV System Project	0	0	0	8	2	8	BEEE0099

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Electronics & Embedded System									
THEORY									
1.	BEEE0112	Digital Signal Processing	3	1	0	0	4	4	
2.	BEEE0110	Biomedical Signal Processing	3	0	0	0	3	3	
3.	BEEE0111	Analog & Digital Communication	3	0	0	0	3	3	
4.	BEEE0115	Medical Image Processing	4	0	0	0	4	4	
5.	BEEC0007	Analog Integrated Circuit	3	0	0	0	3	3	-
6.	BEEC0015	Microprocessor & Its Applications	3	0	0	0	3	3	
PRACTICALS									
7.	BEEE 0890	Medical Image Processing Lab	0	0	2	0	1	2	BEEE 0890
8.	BEEC0811	Microprocessor Lab	0	0	2	0	1	2	BEEC0015

Projects (J)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BEEJ0950	Mini Projects - I	0	0	0	4	1	4	
2.	BEEJ0951	Mini Project - II	0	0	0	12	3	12	
3.	BEEJ0953	Minor Project	0	0	0	12	3	12	
4.	BEEJ0955	Major Project	0	0	0	32	8	0	
5.	BEEJ0991	Industrial Training	0	0	4	0	2	0	
		TOTAL	**0**	**0**	**0**	**60**	**17**		

Mandatory Non Graded Course (M)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
		THEORY							
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
		TOTAL	**8**	**0**	**0**	**0**	**0**	**8**	

Humanities and Social Sciences (H)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purpose – I	2	0	0	0	2	2	
4.	BELH 0004	English for Professional Purpose – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAC0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH 0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	4	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	4	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences (S)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR /WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences (G)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR /WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG1001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BEEG0002	Electrical Technology	3	0	0	0	3	3	
5.	BCSC0001	Computer Programming	4	1	0	0	5	5	
PRACTICALS									
6.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
	BEEG0801	Electrical Simulation Lab	0	0	4	0	2	4	
7.	BEEG0802	Electrical technology Lab	0	0	2	0	1	2	
8.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
9.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
10.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
11.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
TOTAL			16	4	14	0	28	16	

Open Elective (Offer to other Departments)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEO0090	Electrical Machine & Automatic Control	3	0	0	0	3	3	
2.	BEEO0092	Non-Conventional Energy Resources	4	0	0	0	4	4	
PRACTICALS									
3.	BEEO0900	Electrical Machines & Automatic Control Lab	0	0	2	0	1	2	BEEO0090

BEEG 1001: BASIC ELECTRICAL ENGINEERING

Credits: 04 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**DC circuit analysis & Network theorems:** Fundamentals of electric circuits, Kirchhoff's laws, mesh analysis, nodal analysis, Thevenin's theorem, maximum power transfer theorem, superposition theorem. **Steady state AC analysis:** AC fundamentals, average &rms values of different AC waveforms, phasor algebra, analysis of series AC circuits, power triangle, concept of power factor. **Three phase AC circuits:** Generation & advantages of three phase system, star & delta connection, line & phase voltage/current relations.	20
II	**Magnetic circuits:** Faraday's law, circuit analysis, analogy between magnetic and electric circuit, magnetic hysteresis. **Single phase Transformers:** Constructional feature, Working Principle, EMF equation, Ideal transformer, Equivalent Circuit, Phasor diagram, parameter evaluation using O.C & S.C test, efficiency, voltage regulation. **Rotating Electrical Machines:** **DC Machine:** Construction, operating principle, Need of Starter, EMF Equation, Types of DC Motor, Torque Equation, Torque-speed Characteristics and applications. **Induction motor:** 3-phase: Construction & Principle, Need of Starter, Torque Equation, Torque-slip Characteristics. **Single Phase Induction motor:** Principle and Starting methods.	22

Text Book:

- D.C. Kulshrestha, "Basic Electrical Engineering", Tata McGraw Hill.

Reference Books:

- T.K. Nagsarkar&M.S.Sukhija, "Basic Electrical Engineering", Oxford University Press.
- H. Cotton, "Advanced Electrical Technology", 2nd Edition, Wheeler Publishing.
- I. J. Nagarath, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill.
- D. E. Fitzgerald & A. Grabel Higginbotham, "Basic Electrical Engineering", 5th Edition, McGraw Hill.
- Edward Hughes, "Electrical Technology", 3rd Edition, Pearson Education.

Focus: This course focuses on Employability aligned with all COs.

Course Outcome: *After completion of course, students will be able to:*

1. Define the basic concept of active & passive elements, Linear & non-linear elements, Unilateral and Bilateral Elements, Ideal & Practical voltage and current sources.
2. Illustrate the working principle of various machines like DC Machine, and Induction motor.
3. Classify DC motors and induction motors.
4. apply the concept of KVL/KCL, Thevenin's theorem, Super position Theorem and Maximum power transfer theorem to solve the electrical circuits.
5. Compute the parameters of single phase and three phase AC electrical circuits, magnetic circuit and transformer.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PSO1, PSO3
CO4	PO1, PO2, PO3, PO4, PSO2, PSO3
CO5	PO1, PO2, PO3, PO4, PSO2

BEEG0800: ELECTRICAL ENGINEERING LAB

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I, & II	1. To Verify the Thevenin's Theorem (DC Circuits). 2. To Verify the Maximum Power Transfer Theorem (DC Circuits). Also Draw Graph between Power and Load Resistance. 3. To Verify the Superposition Theorem (DC Circuits). 4. To Study the Phenomenon of Resonance in R-L-C Series Circuit and to Draw Graph Between Frequency and Current. Also Show Half Power Points. 5. To Determine the V-I Characteristics of a Semiconductor Diode. Also Calculate Forward and Reverse Static and Dynamic Resistances. 6. To Study the Half Wave and Full Wave (Center Tapped) Rectifier With and Without Filter. Also to Calculate the Ripple Factor in Both Cases (Without Filter). 7. To Study Single Phase (Induction Type) Energy Meter. 8. To Study Various Logic Gates Such as OR, AND, NOT, NAND, NOR. 9. Study of CRO and Measurement of Voltage and Frequency Using CRO. 10. V-I Characteristics of Zener Diode. 11. Identification of Active and Passive Components. 12. V-I Characteristics of Bipolar Junction Transistor in Common Base Mode.	24

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes*: At the end of the course students will be able*

1. Implement the basic electric circuits using rheostats, bread-board, resistors, capacitors, inductors, diodes, transistors, voltage sources, ICs, transformer, DSO/CRO and measuring devices.
2. Measure the various electrical quantities like voltage, current, frequency, power and energy.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1,PO2 ,PO3,PO4/PSO2, PSO3
CO2	PO1,PO2 ,PO3,PO4/PSO2

BEEC0006: BASIC SYSTEM ANALYSIS

Credits:4 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to signals and systems**: Classification of Signals, Transformations of Independent Variables (Time), Singularity Functions: Unit Step, Unit Ramp and Unit Impulse Function, Even and Odd Signals, Periodic and A periodic Signals, Real Exponential Signals, Complex Exponential Signals, Energy and Power Signals, Deterministic and Random Signals, Some more elementary functions – Rectangular Pulse Function, Triangular Pulse Function, Signum Function, Sinc function. **Basic systems**: Causal and Non Causal, Linear & Nonlinear, Time Varying and Time Invariant, System with & without Memory, Stable & unstable systems **Convolution Integral** **Fourier Transform Analysis**: Review of Fourier Transforms, Transform of Basic Signals and Periodic and Complex Waveforms, Properties of Fourier Transform, Initial and Final Value Theorems, Inverse Fourier Transform, Application of Fourier Transform to Analysis of Networks	21
II	**Laplace Transform Analysis**: Review of Laplace Transforms, Transform of Basic Signals and Periodic and Complex Waveforms, Properties of Laplace Transform, Initial and Final Value Theorems, Inverse Laplace Transform, Solution of differential equations using Laplace Transform, Waveform Synthesis, Application of Laplace Transform to Analysis of Networks. **Z-Transform Analysis**: Concept of Z-Transform, ROC, Finite Duration Sequences, Properties of Z-Transform, Inverse Z Transform, Initial and Final Value Theorems, Applications to Solution of Difference Equations. **Analogous System:** Linear Mechanical Elements, Force-Voltage and Force-Current Analogy, Modeling of Mechanical and Electro-Mechanical Systems	21

Text Books:

- D. Roy Choudhury, "Networks and Systems", 2nd Edition, New Age International, 2020
- Tarun Kumar Rawat, "Signals and Systems", 1st Edition, Oxford University Press India, 2010

Reference Books:

- Michael J. Roberts, "Signals and Systems", 3rdEdition, McGraw Hill Education, 2019
- H. P. Hsu and R. Ranjan, "Signals and Systems",Schaum's Outline, 2nd Edition, McGraw Hill Education, 2008
- A. Anand Kumar, "Signals and Systems", 3rd Edition, PHI Learning Private Limited, 2016
- Alan V. Oppenheim, Alan S. Willskyans S. H. Nawab, "Signals and Systems", Prentice Hall India, 1997
- B. P. Lathi, "Principles of Linear Systems and Signals", 2ndEdition, Oxford University Press India, 2009
- Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India Private Limited, 2021

Course Outcomes: Upon completion of this course, students shall be able to

CO1: Understand the difference among various types of signals and their practical applications.
CO2: Evaluate the response of a system for different types of signals.
CO3: Apply the concept of Laplace and Fourier transform for engineering problems.

CO4: Analyse the stability and instability of system with the help of Laplace and Z transform.
CO5: Model a physical system into its analogous electrical system.
CO6: Create the model of physical system based on input and output behavior.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2
CO4	PO1, PO2, PO3, PO4, PSO2, PSO3
CO5	PO1, PO2, PO3, PO4, PSO1, PSO3
CO6	PO1, PO2, PO3, PO4, PSO2,

BEEC 0016: SIGNALS & SYSTEMS

Credits:3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hour
I	**Introduction to signals and systems**: Classification of Signals, Transformations of Independent Variables(Time), Singularity Functions: Unit Step, Unit Ramp and Unit Impulse Function, Even and Odd Signals, Periodic and Aperiodic Signals, Real Exponential Signals, Complex Exponential Signals, Energy and Power Signals, **Basic systems**: Causal and Non Causal, Linear & Nonlinear, Time Varying and Time Invariant, System with & without Memory, Convolution Integral **Fourier and Laplace Transform Analysis**: Review of Fourier & Laplace Transforms, Transform of Basic Signals and Periodic and Complex Waveforms, Initial and Final Value Theorems, Inverse Laplace Transform , Application of Fourier and Laplace Transform To Analysis of Networks,	21
II	**Z-Transform Analysis**: Concept of Z-Transform, ROC, Properties of Z-Transform, Inverse Z Transform, Initial and Final Value Theorems, Applications to Solution of Difference Equations. **Numerical computation of Discrete Fourier transform**: DFT & its Properties Obtaining output for discrete time systems for any arbitrary discrete input signal Discrete time systems, Discrete time convolution (graphical procedure), DFT method using FFT algorithms: Fast Fourier Transform, DIT FFT & DIF FFT algorithms, DFT & IDFT using FFT algorithms DFT using FFT & Inverse DFT, Discrete-time convolution using FFT	21

Text Books:

1. Lathi B P, Principles of Signal Processing & Linear Systems Oxford University Press,

References:

1. A V Oppenheim, A S Willsky, Nawab S N, "Signals & Systems", PHI, Second Edition
2. Nagrath I J, Sharan S N, Ranjan Rakesh & Kumar S, Signals & Systems, Second Edition TMH.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *After completion of this course, the students will be able to*

1. Understand the various types of signals, systems, classification and their properties.
2. Compute the Fourier, Laplace Transform, Z-Transform, DTFT, inverse Laplace Transform and inverse Z-Transform of the given signals and/or systems.
3. Apply the FFT algorithms to compute the DFT of given signals.
4. Analyse the stability of system with the help of Laplace, Z transform, and Fourier transform.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2

BEEC0007: ANALOG INTEGRATED CIRCUIT

Objective: Ability to define, understands and explain the performance characteristics of Op-amp, applications of Op-amp, working of 555 timer, voltage regulators, A/D and D/A converters.

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hour
I	**Review of transistors**: Configurations of BJTs and FETs with their characteristics. **Feedback:** General Feedback Structure; Properties of Negative Feedback Amplifiers and types of feedback amplifier. **Oscillators**: -Conditions for oscillations Basic Principle of Sinusoidal Oscillator, R-C, LC Oscillators. **Current Mirror Circuits:** Current Mirrors using BJT and MOSFETs. Operational Amplifier, Characteristics and Applications: Basic Information of Op-Amp, Operational Amplifier Internal Circuit. DC and AC Characteristics, Instrumentation Amplifier, Applications of Op-Amp. **Active Filters:** First and Second order LP, HP active Filters	21
II	**Active Filters:** First and Second order BP, BS and All pass active Filters **Comparators and Waveform Generators: Comparator**, Regenerative Comparator (Schmitt Trigger), Square Wave Generator (Astable Multi vibrator), Mono stable Multi vibrator, Triangular Wave Generator. Voltage Regulator: Series Op-Amp Regulator, IC Voltage Regulators 555 Timer: Functional Diagram, Mono stable and Astable Operation, Schmitt Trigger. Phase-Locked Loop: Basic Principles, Phase Detector/Comparator, Voltage Controlled Oscillator (VCO), , Monolithic Phase-Locked Loop, PLL Applications A/D and D/A Converters- Weighted Resistors & R-2R D-A Converter, Flash Type, Single Ramp & Dual Ramp A-D Converters.	21

Text Books:

1. A.S. Sedra and K.C. Smith "*Microelectronics Circuits*"4th Edition, Oxford University Press (India).
2. Roy Choudhury, Shail B. Jain "*Linear Integrated Circuits*", 4th Edition, New Age International Publishers

References:

1. R.A. Gayakwad, "*OP-AMP and Linear Integrated Circuits*" Third edition, Prentice Hall of India.
2. Robert L. Boylestad and Louis nashel sky, "*Electronic devices and circuit theory*", Pearson Education/PHI,

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: *After completing the course the student will able -*

1. Explain the operation of BJT, FET, current mirror circuit, Op-amp, voltage Regulators, 555 timer, PLL.
2. Classify the feedback and oscillator circuit, active filters, A/D and D/A converters.
3. Apply the concept of Op-amp for active filters, different waveform generators, and PLL.

4. Evaluate the analog and digital output from A/D and D/A circuit respectively, and cut cut-off frequency of different types of active filters.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, , PSO1, PSO2, PSO3
CO6	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3

BEEC0805: ANALOG & DIGITAL ELECTRONICS LAB

Credits: 01 **L-T-P-J: 0-0-2-0**

Objective: *The laboratory serves the students to impart their essential knowledge of analog and digital electronics, to the circuit design and analysis. This laboratory enhances hands on experience of the students to design different electronic circuits with bread-boards and with different active & passive components.*

Module No.	List of Experiments:	Lab Hours
I,II & III	1. To Study V-I Characteristic of JFET and MOSFET. 2. Realization of Multistage Amplifier Using BJT and Calculation of Current Gain. 3. Realization of comparator and zero crossing detector using op- Amp. 4. Realization of adder and subtractor using op-Amp. 5. Realization of 2nd order active low pass and high pass filter. 6. Realization of triangular and sine wave generator using op-Amp. 7. Realization of Astable and Mono stable multi vibrator using IC 555. 8. Realization of full-adder & full subtractor using logic gates and using Boolean expression. 9. Realization of 4-bit even / odd parity checkers using Ex-OR gate. 10. Realization of 4-bit binary decoder/ demultiplexer. 11. Realization of 2-bit/ 4-bit multiplexer. 12. Realization of decimal to BCD encoder using IC 74147. 13. Realization and implementation of RS, JK, T and D flip-flop using logic gates. 14. Realization and implementation serial in parallel out and parallel in serial out shift register. 15. Realization and implementation 4-bit binary ripple counter using JK flip-flop. 16. Realization and implementation of 2-bit up/down synchronous counter.	24

- **Have to perform any 10 experiments out of these.**

Focus: This course focuses on Employability aligned with all COs.

Outcomes: A student who successfully fulfills the course requirements will have demonstrated an ability to:

CO1: design the electronic circuits with basic resistors, capacitors, ICs, and semiconductor devices with the given set of specifications.
CO2: test, and troubleshoot the analog & digital circuits.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1,PO2 ,PO3,PO4/PSO1, PSO2
CO2	PO1,PO2 ,PO3,PO4/PSO1, PSO2

BEEC 0806: ELECTRICAL MACHINES LAB-I

Credits: 1 **L-T-P-J:0-0-2-0**

Objective: To expose the students to the practical concepts of transformer as well as DC machines in order to analyze its performance.

Module No.	Content	Teaching Hours
I	1. To obtain magnetization characteristics of a D.C. shunt generator. 2. To obtain load characteristics of a compound generator (a) cumulatively compounded (b) differentially compounded. To obtain load characteristics of a D.C. shunt generator 3. To obtain efficiency of a dc shunt machine using Swinburn's test. 4. To perform Hopkinson's test and determine losses and efficiency of DC machine. 5. To obtain speed-torque characteristics of a dc shunt motor. 6. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control 7. To study Ward Leonard method of speed control of dc motor. 8. To perform polarity and ratio test of single phase transformer. 9. To perform open circuit and short circuit test in single phase transformer and find efficiency and voltage regulation. 10. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test. 11. To perform polarity and ratio test on 3-phase transformer. To study various connections of 3-pahse transformers. 12. To study Scott connection of transformers.	24

Focus: This course focuses on Employability aligned with all COs.

Outcome: *After successful completion of the lab student will able to*

CO1: Perform the experiment to analyze the characteristics of DC machines and Transformers.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1,PO4/PSO1, PSO2

BEEC0005: FIELD THEORY & APPLICATIONS

Credits: 3 **L-T-P-J: 3-0-0-0**

Module	Contents	Teaching Hours
I	Coordinate Systems and Transformation: Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar . Electrostatic fields: Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses' Law - Maxwell's equation, Electric dipole and flux line, Energy density in electrostatic fields, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric –constants. Electrostatic fields: Continuity equation and relaxation time, boundary conditions, Electrostatic boundary value problems: Poisson's and Laplace's equations., Methods of Images.	21
II	Magneto statics : Magneto -static fields, Biot - Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density - Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential. Magnetic forces: Materials and devices, Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole. Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy. Waves and Applications: Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form Electromagnetic wave propagation: Wave propagation in loss dielectrics, Plane waves in lossless dielectrics Plane wave in free space. Plain waves in good conductors, Power and the pointing vector, Reflection of a plain wave in a normal incidence. Transmission Lines and Smith Chart.	21

Text Book:

1. M. N. O. Sadiku , "Elements of Electromagnetic", 4th Edition , Oxford University Press

Reference Books:

1. W. H. Hayt and J. A. Buck, "Electromagnetic field theory", 7th Edision., TMH. Pramanik - Electromagnetism: Vol.1 - Theory, PHI Learning Pvt. Ltd

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: *After completion of course student will be able to-*

1. *Define various co-ordinate systems, fundamental laws and physical quantities in electromagnetic fields.*
2. *Evaluate the physical quantities of electromagnetic fields (Field intensity, Flux density etc.) in different medium, force exerted on charged particles and current elements.*
3. *Apply different techniques of vector calculus to understand concepts of electromagnetic field theory.*
4. *Analyze EM wave propagation, plane waves in loss and lossless dielectrics, reflection of in normal incidence, power & pointing vector of EM wave.*

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2/PSO1
CO3	PO1, PO2/ PSO1, PSO2
CO4	PO1, PO2, PO3/ PSO1, PSO3

BEEC0009: ELECTRICAL MACHINES-I

Objective: *To expose the students to the key concepts of transformer as well as DC machines and analyze it's performance.*

Credits:3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Single Phase Transformers**: Review: Classification; principle of operation, e.m.f. equation, equivalent circuit, losses and efficiency: maximum and all-day; voltage regulation. Testing : open circuit and short circuit tests, load test, Sumpner's test. **Autotransformers**: Principle of operation, equivalent circuit, comparison with two winding transformers **Three phase Transformers**: Construction of three phase transformers and their phase groupings; Phase transformation: three-phase to two-phase. Parallel operation of single and three phase transformers. Harmonics in transformers.	22
II	**D. C. Generators**: Construction, lap and wave type windings, function of commutator, emf equation, types of d.c. machines, characteristics. **D.C. Motors**: Armature reaction and its effects. Commutation: method of improving commutation, interpoles. Torque developed, losses and efficiency, Characteristics of different types of d.c. motors, d.c. motor starters. Testing of dc machines.	20

Text Books:
1. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill Education, 2004.
2. J. B. Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons, 2013.
3. Ashfaq Hussain, "*Electric Machines*", Dhanpat Rai and Sons, 2016.

Reference Books:
1. M.G. Say, "*The Performance and Design of AC machines*", Pit man & Sons ,2002.
2. A. E. Fitzgerald, C. Kingsley and Umans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill, 2015.
3. Alexander S. Langsdorf, "Theory of Alternating Current Machinery", McGraw Hill Book Company, 2009.
4. F. Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating Current Machines*", Asia Publishing House, 1962.
5. Alexander S. Langsdorf, " Principles of Direct-current Machines", McGraw Hill Book Company,1940.
6. Albert E.Clayton,"The Performance and Design of Direct Current Machines", The English Language Book Society,2000.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: After completion of the course, the students will be able to:

- CO1: Understand the construction and principle of operation of single, three phase transformers and auto transformers.
- CO2: Demonstrate construction and operation of DC generators and DC motors.
- CO3: Evaluate the performance in terms of efficiency, voltage regulation of transformers, and the methods of testing of transformers like open and short circuit tests and the Sumpner's test.

- CO4: Analyze the performance of DC machines by various testing methods including Ward leonard, Swinburn's and Hopkinson.

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO2, PSO3
CO5	PO1, PO2, PO3, PO4, PSO1
CO6	PO1, PO2, PO3, PO4, PSO1, PSO2

BEEC0010: ELECTRICAL MACHINES-II

Objective: To expose the students to the key concepts of synchronous as well as induction machines and analyze it's performance.

Credits:3 **L-T-P-J:3-0-0-0**

Module	Content	Teaching Hour
I	**Synchronous Machine-I:** constructional features, emf equation, winding coefficients, rotating magnetic field, armature reaction and Two Reaction Theory, phasor diagram based on Two Reaction Theory, expression for power developed in terms of load angle, open and short circuit tests, voltage regulation by Synchronous Impedance Method, MMF Method, ASA Method, Operation on infinite bus bar, parallel operation of synchronous generators, active and reactive power control of alternators operating on infinite bus bar. **Synchronous Machine-II:** starting of synchronous motors, effect of variation of field current at constant load and V-Curves, synchronous condenser, synchronizing power and torque, hunting.	21
II	**Three phase Induction Machine-I:** constructional features, principle of operation, phasor diagram, equivalent circuit, power flow and efficiency, relation between rotor power input, mechanical power developed and rotor copper loss, expression for torque and torque-slip characteristics. **Three Phase Induction Machine-II:** determination of parameters of equivalent circuit by no load and blocked rotor tests, methods of starting of three phase induction motors. Deep bar and double cage rotors, harmonics and its effects: cogging and crawling, induction generator and its applications. **Single Phase Induction Motor:** Double Revolving Field Theory, equivalent circuit, no load and blocked rotor tests. Different types of single phase induction motors: starting methods, characteristics and applications.	21

Text Books:

1. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill Education, 2004.
2. J.B.Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons, 2013.
3. Ashfaq Hussain, "*Electric Machines*", Dhanpatrai and Sons, 2016.

Reference Books:

1. M.G. Say, *"The Performance and Design of AC machines",* Pit man & Sons, 2002.
2. A.E. Fitzgerald, C. Kingsley and Umans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill Education, 2015.
3. Alexander S. Langsdorf, "Theory of Alternating Current Machinery", McGraw Hill Book Company,2009.
4. F. Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating Current Machines*", Asia Publishing House, 1962.

Focus: This course focuses on Employability aligned with all COs.

Course Outcome*: After completion of course student will be able to*

CO1: Explain constructional details of different type of Synchronous and Induction Machines, working principle and speed control concept of Induction Motors.
CO2: Demonstrate the parallel operation of alternators with supply mains.
CO3: Calculate the performance parameters of single phase and three phase induction motors.
CO4: Analyze the performance of synchronous machines by V Curves.
CO5: Evaluate the effects of harmonics on three phase induction motors.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO):

Cos	Pos/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO2
CO3	PO2, PO4, PSO3
CO4	PO1, PO2, PO3, PSO3
CO5	PO2, PO3, PO4, PSO3

BEEC0807: ELECTRICAL MACHINES LAB-II

Objective: To expose the students to the practical concepts of synchronous as well as induction machines in order to analyze its performance.

Credits: 1 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I	**Hardware based experiments** 1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit. 2. To perform load test on a three phase induction motor and draw: Torque -speed characteristics 3. To study speed control and reversal of direction of rotation of three phase induction motor by varying supply voltage. 4. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) Z P F method 5. To determine V-curves and inverted V-curves of a three phase synchronous motor at no load 6. To determine Xd and Xq of a three phase salient pole synchronous machine using the slip test and draw the power-angle curve. 7. To study synchronization of an alternator with the infinite bus by using two bright and one dark lamp method. **Software based experiments** 8. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance in the rotor circuit. 9. To determine speed-torque characteristics of single phase induction motor and study the effect of voltage variation. 10. To determine speed-torque characteristics of a three phase induction by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.	24

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *After performing experiments in this lab, students will able to*

- CO1: Perform and analyze the various characteristics of various AC machines.
- CO2: Simulate the speed torque characteristics of induction machines in Mat lab.

Mapping of Course Outcomes (CO) with Program Outcomes (PO) and Program Specific Outcomes (PSO):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1,PSO2
CO2	PO1, PO2, PO5, / PSO1, PSO2, PSO3

BEEC 0008: DIGITAL ELECTRONICS & CIRCUITS

Objective: To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Number Systems &Codes**: Decimal, binary, octal, hexadecimal number system and conversion, Floating point representation, 1's &2's complement, Signed binary numbers, signed binary numbers, weighted binary codes, Excess 3 code, Error Detecting and Correcting Codes. **Boolean Algebra & Minimization**: Boolean logic operation, Boolean laws, Digital Logic Gates, Demorgan's Theorems, Gate-level minimization: K-Map, POS simplification. **Combinational Logic**: Combinational circuits, analysis procedure, design procedure, Binary Adder-Sub tractor, Multiplexers, De-multiplexer, Decoders, Encoders.	20
II	**Synchronous sequential logic:** Sequential Circuits, Storage Elements: Latches, Flip Flops (S-R, J-K, D, T, MASTER SLAVE), Analysis of Clocked Sequential Circuits. **Registers and Counters:** Shift Registers, Ring Counter, Ripple Counter, Synchronous Counter, Other Counters. **Digital integrated circuits:** Logic levels, propagation delay time, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics TTL, CMOS and ECL integrated circuits and their performance comparison, open collector and tri-state gates and buffers. **Memory and programmable logic:** RAM , ROM, PROM, and EPROM.	20

Text Book:

1. M. Morris Mano and M. D. Ciletti, "*Digital Design*" 6th Edition, Pearson Education.
2. S. Salivahanan& S. Asivazhagan, "*Digital Circuit & Design*", IInd Edition

Reference Books:

1. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
2. John. M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2002.
3. Charles H.Roth. Fundamentals of Logic Design, Thomson Learning, 2003.
4. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, 6thEdition, TMH, 2003.
5. William H. Gothmann, Digital Electronics, 2nd Edition, PHI, 1982.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

1. Understand the basics of number system and different logic families.
2. Implement general problems on combinational circuits using optimized logic gates.
3. Construct sequential circuits which includes latches, fli- flop, shift register,ripple counter, synchronous counter, ring counter and also analysis of clocked sequential circuits.
4. Analyse the performance of memory devices like RAM, ROM, PROM, EPROM.

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

Cos	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 / PSO1, PSO2
CO3	PO1, PO2 /PSO1, PSO3
CO4	PO1, PO2, PO3 / PSO1, PSO3

BEEC0014: POWER ELECTRONICS

Objective: The course aims to enable students to understand application of power semiconductor switches in modern power application, and to analyze performance of different power electronics converters for various industrial and household applications.

Credits: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Thyristor:** Construction, V-I and Switching characteristics (Turn-On and Turn-Off), Two Transistor Model, Methods of Turn-On, Operation of GTO, DIAC, TRIAC, Firing Circuits for SCR, Protection of Devices, Series and Parallel Operation of Thyristors. **Commutation:** Commutation Techniques of Thyristor. **Phase Controlled Converters:** Single Phase Half Wave Controlled Rectifier With Resistive and Induction Loads, Effects of Freewheeling Diode, Single Phase Fully Controlled and Half Controlled Bridge Converters, Performance Parameters, Three Phase Half Wave Converters, Three Phase Fully Controlled and Half Controlled Bridge Converters, Effect of Source Impedance, Single Phase and Three Phase Dual Converters.	20
II	**Inverters:** Introduction (VSI), VSI-Single Phase Half and Full Bridge Inverters for R, RL and RLC Loads, Three Phase Bridge Inverters 180° and 120° Mode Operations. CSI-Single Phase Series Resonant and Parallel Inverters, Voltage Control of Inverters, Harmonic Reduction Techniques. **DC-DC Converters:** Principle of Step-Down Chopper, Step Down Chopper, control strategies for varying duty cycle, quadrant base classification of Choppers. **Cyclo converters:** Basic Principle of Operation, Single Phase to Single Phase, Three Phase to Single Phase and Three Phase to Three Phase Cyclo converters, Output Voltage Equation. **AC Voltage Controllers:** Introduction, Single Phase Ac Voltage Controller With Resistive and Inductive Loads, Three Phase Ac Voltage Controllers (Various Configurations And Comparison Only).	22

Text Books:

1. M. H. Rashid, Power, "Electronics: Circuits, Devices & Applications", Prentice Hall of India Ltd, 4th edition, 2013.

References:

1. M.D. Singh & K. B. Khanchandani "*Power Electronics*", TMH, 2nd edition (paperback), 2017.
2. Ned Mohan, T. M. Undeland and W. P. Robbins, "*Power Electronics: Converters, Applications and Design*", Wiley India Ltd, 3rd edition (paperback), 2009.
3. S. N. Singh, "*Modern Power Electronics and AC Drives*", Prentice Hall, 2001 (paperback edition).
4. V.R. Moorthy, "*Power Electronics: Devices, Circuits, Industrial Applications*", Oxford Univ. Press, 2005 (paperback edition).
5. P.S. Bhimbra, "*Power Electronics*", Khanna Publishers, 2018.

Course Outcomes: *After learning the course the students should be able to:*

CO1: Understand the switching characteristics and working of power semiconductor devices such as SCR, GTO, DIAC, TRIAC.

CO2: Compare the power converter performance for practical loads (R and RL).

CO3: Apply the different modulation techniques to PWM inverters for harmonic reduction.

CO4: Design power converter (controlled rectifier, inverter, DC-DC Converters, cyclo converters and ac voltage controller) circuits by assessing the requirements of application fields.

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1,
CO3	PO1, PO2, PO3, PO4, PSO2,PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2, , PSO3
CO5	PO1, PO2, PO3, PO4, PSO1, PSO3
CO6	PO1, PO2, PO3, PO4, , PSO3

BEEG0003: ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

Objective: To understand the internal structure of all instruments that are used in measuring parameters and also difference between analogue meters and digital meters and their performance characteristics.

Credits: 3 **L-T-P-J:3-0-0-0**

Module	Content	Teaching Hour
I	Philosophy of Measurement: Methods of Measurement, Classification & Characteristics of Instrument & Measurement System, Errors in Measurement & Its Analysis, Standards. Measurement of Current and voltage: Classification of Analog instruments. Principle of operation, construction, sources of error and compensations in PMMC, Dynamometer type instruments. Extension of ranges and calibration of ammeters & voltmeters. Measurement of power Power measurement – Voltmeter ammeter method, Electrodynamics wattmeter – Theory, errors and compensation. Instrument Transformers: Instrument Transformers and Applications in the Extension of Instrument Range. Measurement of Circuit Parameters: Different Methods of Measuring Low, Medium and High Resistances, Measurement of Inductance,	21
II	Measurement of Capacitance & Frequency with The Help of AC Bridges. Potentiometer. Sensors and Transducers: Classification of Sensors &Transducers, Resistive Transducers, Inductive Transducers. Digital Measurement: Concept of Digital Measurement, Block Diagram Study of Digital Voltmeter, Frequency Meter Power Analyzer and Harmonics Analyzer; Digital Multi meter Cathode Ray Oscilloscope: Basic CRO Circuit (Block Diagram), Cathode Ray Tube (CRT) & Its Components, Application of CRO in Measurement, Lissajous Pattern; Digital storage oscilloscope (Block Diagram, theory and applications only)	21

Text Books:

1. G.K. Banerjee, Electrical Measurement & Measuring Instruments, New Age International.

A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai &Sons India.

References:

1. Forest K. Harris, "Electrical Measurement", Willey Eastern Pvt. Ltd. India.
2. M.B. Stout, "Basic Electrical Measurement" Prentice hall of India, India.
3. Helfrick and Cooper, "Modern Electronic Instrumentation & Measurement Techniques", PHI
4. Learning.
5. Rajendra Prashad, "Electrical Measurement & Measuring Instrument", Khanna Publisher.
6. J.B. Gupta, "Electrical Measurements and Measuring Instruments", S.K. Kataria& Sons.
7. MMS Anand, "Electronic Instruments and Instrumentation Technology", PHI Learning.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

1. Understand measuring parameters, methods, standards, characteristics and errors in electrical and electronic measuring instruments.
2. Explain the application of CT, PT, resistive, inductive and capacitive transducers oscilloscopes and recorders.
3. Evaluate active power, power factor using wattmeter methods & resistance, inductance and capacitance using ac, dc bridges.
4. Analyse the performance characteristics of measuring instruments such as extension of range, Lissajous pattern etc.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes(PSO)

Cos	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 / PSO1
CO3	PO1, PO2 / PSO1, PSO2
CO4	PO1, PO2, PO3 / PSO1, PSO2, PSO3

BEEC0810: POWER ELECTRONICS LAB

Credits: 1 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I,II & III	**LIST OF EXPERIMENTS** 1. To study V-I characteristics of SCR and measure latching and holding Currents. 2. To study UJT trigger circuit for half wave and full wave control. 3. To study single-phase half wave controlled rectified with (i)resistive load (ii) inductive load with and without free-wheeling diode. 4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and Inductive loads. 5. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads. 6. To study single-phase ac voltage regulator with resistive and inductive loads. 7. To study single phase cyclo-converter. 8. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor 9. To study operation of IGBT/MOSFET chopper circuit. 10. To study MOSFET/IGBT based single-phase bridge inverter. 11. To obtain illumines control using TRIAC. **SOFTWARE BASED EXPERIMENTS (PSPICE/MATLAB)** 12. To obtain simulation of SCR and GTO thyristor. 13. To obtain simulation of Power Transistor and IGBT. 14. To obtain simulation of single phase fully controlled bridge rectifier and draw load voltage load current waveform for inductive load. 15. To obtain simulation of single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load. 16. To obtain simulation of step down dc chopper with L-C output filterfor inductive load and determine steady-state values of output voltage ripples in output voltage and load current. To perform 8-10 experiment from the above list	24

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *At the end of the course students will be able to,*

CO1: control the output of SCR based rectifiers and loads .

CO2: develop and troubleshoot MATLAB circuits for rectifiers, inverters and choppers.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1,PO2 ,PO3,PO4/PSO1,
CO2	PO1,PO2 ,PO3,PO4/PSO1, PSO1, PSO2
CO3	PO1,PO2 ,PO3,PO4/PSO3

BEEC 0018: Power System Transmission & Distribution

Objective: *The objective of the subject is to identify major components of power transmission and distribution systems. Describe the principle of operation of transmission and distribution equipment & to know and appreciate the key factors in equipment specification and design.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Overhead Transmission Line:** Types of conductors; Stranded conductors, ACSR Conductor, bundle conductors. Parameters of transmission line; Resistance, Inductance, Capacitance & conductance. Method for calculations of Inductance & Capacitance of 1-phase & 3-phase single circuit & double circuit Line, concept of GMR and GMD. Skin and proximity effect. **Performance of Transmission Line:** Characteristics & Performance of Transmission Lines; Short, Medium & Long Lines, Generalized Constants. Voltage Regulation and efficiency. Ferranti Effect. **Mechanical Design of Overhead Transmission Line:** Tension & Sag Calculation, Effect of weather conditions. Vibration & dampers. **Insulators:** Insulator materials & types – pin, disc & strain. Voltage distribution across a string &string efficiency. Methods to improve string efficiency; Capacitance grading & Guard ring.	21
II	**Corona:** Corona - Visual & Disruptive, Critical Disruptive Voltage. Corona Loss. Factors affecting Corona, Methods of reducing Corona, Electrostatic & Electromagnetic interference with Communication lines. **Insulated Cables:** Constructional features, Parameters, Cable laying procedures. High Voltage Cables & Thermal characteristics, Fault Location. **Distribution System:** Primary & Secondary Distribution, Ring Main & Radial System, Design of distribution system. **Representation of Power System:** Single Line Diagram, Per Unit system of calculation. Formation of Y-Bus & Z-Bus. **Load Flow Study:** Load Flow Problem, Power Flow Equations, Load Flow solution using Gauss Seidel& Newton Raphsonmethods, decoupled &fast decoupled method, Reactive Power Compensation.	21

Text Books:

1. D.P. Kothari and I.J. Nagarath, "Power System Engineering", TMH.
2. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill.
3. M. V. Deshpande, "Electrical Power System Design" Tata Mc Graw Hill.

Reference Books:

1. B.R. Gupta, "Power System Analysis & Design", S. Chand & Co.
2. Chakraborthy, Soni,Gupta&Bhatnagar, "Power System Engineering", DhanpatRai& Co.
3. HaadiSaadat, "Power System Analysis", McGraw Hill Publication.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1. Understand the skin effect, proximity effect, overhead line conductors and underground cables in power transmission.

CO2. Compute the electrical parameters of overhead transmission lines using the concept of GMD and GMR and load flow problem and various methods.
CO3. Analyze the performance of overhead transmission line, voltage regulation, efficiency and power transfer capability.
CO4. Design overhead transmission lines considering mechanical parameters, insulator, Corona aspects and distribution systems.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

Cos	**POs/ PSOs**
CO1	PO1, PO2 /PSO3
CO2	PO1, PO2 / PSO3
CO3	PO1, PO2 / PSO3
CO4	PO1, PO2, PO3 / PSO3

BEEC0012: ELEMENTS OF POWER SYSTEM

Credits: 03 **L-T-P-J: 3-0-0-0**

Course Objective: The objectives of this course are to make the students

1. *understand basic structure of power system*
2. *Understand and calculate transmission line parameters*
3. *Evaluate the electrical and mechanical performance of transmission lines*
4. *Understand insulators, corona effect, cables, distribution systems power system earthing and HVDC and EHVAC transmission systems.*

Module No.	Content	No. of Lectures
I	**Introduction:** Structure of Power Systems, Overview & growth of Power Systems; Indian-Scenario, Interconnections and their advantages **Transmission Lines:** Choice of voltage and frequency, Types of conductors, Bundled conductors. Calculation of Electrical parameters of Overhead Transmission Lines; Resistance, Inductance and Capacitance using the concept of GMR and GMD for 1-Phase, 3- Phase, Single Circuit & Double Circuit Lines, Skin effect, Proximity effect. **Transmission Line Performance-I:** Characteristics and Performance of Transmission Lines; Short and Medium - Generalized Constants, Power flow, and Voltage regulation. **Transmission Line Performance-II:** Characteristics and Performance of Long Transmission Lines, Ferranti Effect, Surge Impedance & Surge Impedance Loading. Indian Electricity Rules. **Mechanical Design of Overhead Transmission Lines:** Tension and Sag Calculations, Effect of weather conditions, Stringing Charts, Vibration & Damper.	22
II	**Insulators:** Insulator Types, String Efficiency & Methods to improve String efficiency; Capacitance grading, Guard ring. **Corona and Interference with Communication Lines:** Corona; Visual and Disruptive, Critical Voltage, Corona Loss, Factors affecting Corona. Methods of reducing Corona, Interference with Communication Lines. **Insulated Cables:** Constructional Features, Parameters. Electric stress in single-core cable, grading of cable. Cable laying procedures, Fault location methods. High Voltage Cables. Thermal Characteristics of cables. **Distribution Systems:** Primary and Secondary Distribution, Ring Main and Radial Systems, Systematic design of Distribution Systems. **Power System Earthing:** Soil Resistivity, Earth Resistance, Tolerable Step and Touch Voltage, Actual Touch and Step Voltages, Design of Earthing Grid. **HVDC Transmission and EHV-AC Transmission:** Introduction to HVDC and EHV-AC transmission systems and their comparison.	21

Text Books:

1. D.P. Kothari and I.J. Nagrath, "*Power System Engineering*",3rd edition Tata McGraw Hill, 2019.
2. B. R. Gupta, "*Power System Analysis and Design*", 7th Edition, S. Chand Publishing, 1998
3. John J. Grainger and W. D. Stevenson, Jr, "*Power System Analysis*", 1st Edition, Tata McGraw-Hill, 2004

References:

1. Ashfaq Husain, "Electrical *Power System",*5th Edition, CBS Publishers and Distributors, 2014
2. C. L. Wadhwa, "*Electrical Power Systems*", 7th Edition, New Age International Ltd., 2017
3. S. N. Singh, "Electric Power Generation, Transmission& distribution." 2nd Edition, PHI Learning, 2021

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: After completion of the course, students shall be able to:

CO1. Understand the structure of an interconnected power system including generation, transmission and distribution; their function and growth, skin effect and proximity effect.
CO2. Understand the mechanical design of overhead transmission lines considering insulation and Corona aspects and also the constructional features of single and multi-core cables, grading and thermal rating of cables, electric distribution system, power system earthing, HVDC and EHVAC Transmission.
CO3. Calculate the electrical parameters of overhead 1-phase and 3-phase transmission lines using the concept of geometrical mean distances and geometrical mean radius.
CO4. Analyze short, medium and long transmission line models to obtain their performance – voltage regulation, efficiency and power transfer capability.
CO5. Evaluate sag and tension, string efficiency, electric stress in cables and fault location, minimum voltage point for different distribution systems, soil resistivity, step and touch voltage in substations.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO2,
CO4	PO1, PO2, PO3, PO4, PSO2, , PSO3
CO5	PO1, PO2, PO3, PO4, PSO1,

BEEC 0013: POWER SYSTEM ANALYSIS

Credits: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Representation of Power System:** Single Line Diagram, Impedance & Reactance Diagram, Per Unit System of calculation. **Load Flow Study:** Network model. Formation of Y_{BUS} by inspection and by graph theory. Formulation of load flow problem. Gauss-Seidel method of load flow-analysis. Representation of voltage-controlled buses in load-flow analysis. Newton-Raphson method of load-flow analysis. Decoupled and Fast Decoupled Methods, Comparison of Load Flow Methods. **Economic Operation of Power Systems:** Economic dispatch problem in thermal power stations. Consideration of transmission losses in economic dispatch. Development of loss-formula. **Fault Analysis**: Types of Fault. Synchronous machine model for fault analysis. Calculation of Fault Current and voltages for symmetrical short circuit.	21
II	**Fault Analysis**: Symmetrical components of unbalanced phasors, power invariance transformation. Sequence impedance and sequence network of power system elements. Unsymmetrical short-circuits. Open conductor fault. Z_{BUS} method for the analysis of unsymmetrical shunt faults. Current limiting reactors. **Transient Stability Studies**: Types of Stability, Swing Equation, coherent group of machines. Power Angle Curve. Equal Area Criterion & Its Applications; Step-by-Step Solution of Swing Equation. Factors affecting stability of system & methods of improving stability **Surge Phenomenon**: Classification of Over-voltages; Travelling Wave Equation for a Long Line, Surge Impedance. Reflection and refraction of surges, Bewly Lattice diagram. Protection from Surges.	20

Text Books:

- I.J. Nagrath and D.P. Kothari, "*Modern Power System Analysis*", Tata McGraw Hill, 4th edition.
- J. Grainger & W. D. Stevenson, "*Power System Analysis*", McGraw Hill.
- B. R. Gupta, "Power System Analysis and Design", S. Chand & Co.

References:

- C. L. Wadhwa, "Electrical Power Systems", New Age International Ltd.
- AshfaqHussain, "Power System", CBS Publishers and Distributors.
- Chakraborthy, Soni,Gupta&Bhatnagar, "Power System Engineering", DhanpatRai& Co.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completing the course, the students shall be able to:

1. Understand the methods of Y bus, Z bus formulation and G-S, N-R and fast decoupled methods of load flow analysis, over-voltage classification methods of improving stability in power system.
2. Calculate per unit system values, sequence components, fault currents, critical clearing angle, reflection and refraction coefficient for voltage and current wave in transmission line.
3. Evaluate the condition of economic scheduling of thermal power plants including transmission losses.
4. **A**nalyze symmetrical, unsymmetrical faults, economic scheduling and load dispatch, transient stability and traveling wave phenomenon's in power systems.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1,PO2 ,PO3,PO4/PSO1,
CO2	PO1,PO2 ,PO3,PO4/PSO1, PSO2
CO3	PO1,PO2 ,PO3,PO4/PSO2
CO4	PO1,PO2 ,PO3,PO4/PSO1, PSO3

BEEC0015: MICROPROCESSOR & IT's APPLICATIONS

Objective: *The Purpose of the course is to provide students with the Knowledge of Microprocessors, basic of Microcontroller and peripheral. To solve real world problems in an efficient manner, this course also emphasis on architecture, Programming and system design used in various day-to-day gadgets.*

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	Introduction to Microprocessor, Components of a Microprocessor: Registers, ALU and control & timing, System bus (data address and control bus), Microprocessor systems with bus organization. Microprocessor Architecture and Operations, Memory, I/O devices, Memory and I/O operations. 8085 Microprocessor Architecture, Address, Data And Control Buses, 8085 Pin Functions, Demultiplexing of Buses, Generation Of Control Signals, Instruction Cycle, Machine Cycles, T-States, Assembly Language Programming Basics, Classification of Instructions, Addressing Modes, 8085 Instruction Set, Instruction and Data Formats, Writing, Assembling & Executing a Program, Debugging the Programs. Writing 8085 assembly language programs with decision, making and looping using data transfer, arithmetic, logical and branch instructions.	21
II	Stack & Subroutines, Developing Counters and Time Delay Routines, Code Conversion, BCD Arithmetic and 16-Bit Data operations, Interrupts In 8085, Interfacing Concepts, Memory Interfacing ,Ports, Interfacing Of I/O Devices, , Programmable Peripheral Interface 8255A, TIMER IC 8253,Programmable Interrupt Controller 8259A, **Advanced Microprocessors**: 8086 logical block diagram and segments, Addressing Modes, **Introduction to Microcontrollers and Embedded Processors**	21

Text Book:

1. B Ram "Fundamental of Microprocessor & Microcontrollers", DhanpatRai publication.

Reference Books:

1. Ramesh S. Gaonkar , "Microprocessor Architecture, Programming, and Applications" with the 8085, Pub: Penram International.
2. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah "Microprocessors and Interfacing", Oxford
3. Daniel Tabak "Advanced Microprocessors", McGrawHill.
4. Douglas Hall "Microprocessor & Interfacing" , TMH.
5. Savaliya M. T. "8086 Programming and Advance Processor Architecture", WileyIndia.
6. Triebel& Singh "The 8088 and 8086 Microprocessors", Pearson Education.
7. Kenneth Ayala "The 8051 Micro controller" 3rd Edition.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *After learning, the course the students should be able to:*

1. *Understand the various features of microprocessor,* microcontrollers and embedded system *,memory and I/O devices including concepts of system bus and 8085 processor addressing modes, instruction classification, function of each instruction, and write the Assembly language programs using 8085 instructions.*
2. *Explain the architecture of 8085 and 8086 microprocessor, its bus organization including control signals.*
3. *Analyze the concepts of memory and I/O interfacing with 8085 processor with Programmable devices.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1, PO2/PSO1
CO3	PO1,PO2/PSO1, PSO2

BEEE 0054: PROCESS CONTROL & ADVANCE INSTRUMENTATION

Objective: *To prepare the students have successful career in industry and motivate for higher education. To provide strong foundation in basic science and mathematics necessary to formulate, solve and analyze Control and Instrumentation problems.*

Credits:
04 **L–T–P: 4–0–0**

Module	Content	Teaching Hours
I	**Introduction to Industrial Automation and control:** Architecture of Industrial automation systems. **Introduction to Sensors and Measurement systems**: Temperature measurement, pressure and force measurement, displacement and speed measurement, flow measurement techniques, measurement of level, humidity and ph. Signal conditioning and processing estimation of errors and calibration. **Introduction to Process Control**: Process characteristics, proportional(P),integral(I),derivative(D),PI,PD and PID Control modes, controller tuning. **Special Control Structures**: Feed-forward and ratio control, predictive control, control of systems with inverse response cascade control, overriding control, selective control, split range control, Electronic, pneumatic and digital controllers.	21
II	**Electrical Control elements**: Construction and principle of operation of solenoids, stepper motor, AC/DC motor, limit switches, relays, auto transformer and magnetic amplifiers. **Introduction to Actuators**: Flow control valves. Control valves: Principle of operation and constructional details of solenoid valves, diaphragm operated valve, piston operated valve, valve petitioners, control valve characteristics and their sizing, temperature switches flow switches, interlocking and sequencing circuits. Hydraulic **Actuator systems**: Principles, components and symbols, pumps and motors, proportional and servo valves. **Pneumatic Control systems**: System components, controllers, and integrated control systems. Introduction to Sequence control: PLCs and relay ladder Logic.	21

Text Book:

- George Stephanopoulos, “Chemical Process Control: An Introduction to Theory and Practice”, Prentice-Hall, 1984.

References:

- Harrist P, “Process Control”, McGraw Hill.
- Johnson, Curtis D, “Process Control Instrumentation Technology”, John Wiley and Sons.
- B.C. Nakra&K.Chaudhry, “Instrumentation, Measurement and Analysis”, Tata McGraw Hill 2nd Edition.
- A.K.Sawhney, “Advanced Measurements & Instrumentation”, DhanpatRai& Sons.

Outcomes:

- *Ability to understand and apply basic science, circuit theory, control theory signal processing and*
- *Apply them to engineering problems.*
- *Ability to model and analyze transducers.*
- *Ability to understand and analyze Instrumentation systems and their applications to various industries.*
- *Ability to apply advanced control theory to practical engineering problems.*

Outcomes:

1. *Understand the basic components of instrumentation system.*
2. *Explain various measurements such as temperature, speed, flow, pressure etc. Design a data acquisition system.*
3. *Analyze the working of transducer, Instrumentation systems, and their applications to various industries.*
4. *Explain the construction and operating principle of feed forward and ratio control, electronic pneumatic and digital control.*

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2

BEEE 0030: ELECTRICAL POWER GENERATION

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Importance of Electrical Energy, Comparison with other forms of energy. Electrical energy sources. **Power Plant Economics and Tariffs:** Load Curve, Load Duration Curve, Different Factors related to plants and consumers, Cost of electrical energy. Depreciation, Tariffs, Causes and effects of low power factor. Different methods for power factor improvement and advantages of pf improvement. **Power Plant Auxiliaries:** Excitation system, Turbine and Governors, Storage Batteries. EHV Substation – classification & its equipment. **Thermal Power Plant:** Location and site selection, general layout and working of plant. Brief description of Boilers, Economizers, Super heaters, Draft system. Fuel and Ash handling plant. **Gas Turbine Power Plant:** Layout & operational principle of Gas Turbine Plant & its efficiency, Fuels, Open and Closed-cycle plants, Regeneration, Inter-cooling and reheating.	21
II	**Nuclear Power Plant:** Location, Site selection, General layout and operation of plant, Brief description of different types of Reactors, Moderator material, Fissile materials. Control of nuclear reactors, Disposal of nuclear waste, Shielding. **Hydro Electric Plants:** Classifications, Location and site selection, Detailed description of various components, General layout and operation of plants, Brief description of Impulse, Reaction, Kaplan and Francis turbines. Advantages & disadvantages. **Wind Energy:** Basic principles of Wind energy conversion, Wind energy power calculation, Analysis of aerodynamic forces acting on the Blades, Site selection considerations, Types of wind energy Collectors, applications of wind energy. **Solar Energy:** Solar radiation at the Earth's surface, Solar radiation measurement, Solar energy Collectors, Solar Thermal Power Plant, Solar PV Cells. Applications of Solar Energy. **Neutral Earthing:** Introduction, isolated neutral, earth neural systems-solid, resistance & reactance. Arc suppression coil, voltage transformer earthing transformer. Substation Automation: Requirement & Cost Justification.	21

Text Books:

1. B. H. Khan, "*Non-conventional Energy Resources*", 2nd Edition 2009, Tata Mcgraw-Hill Education.
2. B. R. Gupta, "*Generation of Electrical Energy*", 7th Edition 2017, S. Chand Publication 2017.

References:

1. Soni, Gupta & Bhatnagar, "*A Text Book on Power System Engg. 2nd Edition, 2000",* Dhanpat Rai & Co.

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: At the end of the course the students will be able to:

1. Understand the concept of various economic factors, load curve, load duration curves, excitation system, turbine & governor and stations storages batteries
2. Explain the operating principle and layout of thermal, hydro, nuclear, gas, wind and solar power plants.
3. Analyze the cost of energy generated, type of tariffs, most economic power factor selection, fill factors & power output of solar PV plant.
4. Classify the neutral earthing and explain requirement of substation automation and cost justifications.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2/PSO1
CO3	PO1/PSO1, PSO2, PSO3
CO4	PO1, PO2/PSO1, PO2

BEEE 0031: HIGH VOLTAGE ENGINEERING

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	Level of high voltage, electrical insulation and dielectrics, importance of electric field intensity in the dielectrics. **Break Down In Gases:** Properties of atmospheric air, SF6 and vacuum ionization processes, Townsend's criterion, breakdown in electronegative gases, time lags for breakdown, Streamer theory, Paschen's law, and breakdown in vacuum. **Break Down In Liquid Dielectrics:** Classification & Properties of liquid dielectric, characteristic of liquid dielectric, breakdown in pure liquid and commercial liquid. **Break Down In Solid Dielectrics**: Classification & Properties of solid dielectrics, intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric in Practice, breakdown in composite dielectrics.	20
II	**Generation of High Voltages and Currents:** Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of Impulse generator sources of overvoltage. **Measurement of High Voltages and Currents:** Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements. **Non-Destructive Testing:** Measurement of direct current resistively, measurement of dielectric constant and loss factor, partial discharge measurements. **High Voltage Testing:** Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, testing of transformers, testing of surge arresters.	21

Text Books:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", 5th Edition, 2017, Tata Mc-Graw Hill.

References:

1. E. Kuffel and W. S. Zacngal, "High Voltage Engineering", 2nd Edition, 2000, Pergamon Press.
2. C. L. Wadhwa, "High Voltage Engineering", 2nd Edition, 2007, Wiley Eastern Ltd.

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes*:* At the end of the course the students will be able to:

1. *Understand fundamental concepts of high voltage AC, DC, impulse generation and destructive and non destructive testing procedure of power equipments.*
2. *Apply the different measurement technique to compute high ac/dc voltage and current*
3. *Analyze the reasons behind electric breakdown in liquids, gases, and solids.*
4. *Design the various ac/ dc high voltages and current generation circuits.*

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1, PO2/PSO1
CO2	PO1, PO2, / PSO1, PSO2
CO3	PO1, PO2/PSO3
CO4	PO1, PO2, PO3/ PSO1, PSO2, PSO3

BEEE 0032: SMART GRID

Objective: *To enable the students to acquire knowledge on smart grid, different options of architectural design and sensors, measurement technology for various aspects of smart grid, renewable energy sources and power quality management, information and communication technology for smart grid.*

Credits: 03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	Introduction to Smart Grid: Evolution of electric grid, concept of smart-grid, definitions, need of smart grid, functions of smart grid, opportunities & barriers of smart grid, difference between conventional & smart grid, concept of resilient &self-healing grid, present development & international policies on smart grid. Smart Grid Technologies: Part 1 Introduction to smart meters, real time pricing, smart appliances, automatic meter reading(AMR), outage management system(OMS), plug in hybrid electric vehicles(PHEV), vehicle to grid, smart sensors, home & building automation, phase shifting transformers. Smart Grid Technologies: Part 2 Smart-substations, substation automation, feeder automation. geographic information system(GIS), intelligent electronic devices(IED) & their application for monitoring & protection, smart storage like Battery, SMES, pumped hydro, compressed air energy storage, wide area measurement system(WAMS), phase measurement unit(PMU).	22
II	Power Quality Management in Smart Grid Power Quality & EMC in Smart Grid, power quality issues of grid connected renewable energy sources, power quality conditioners for smart grid, web based power quality monitoring, power quality audit. Information and Communication Technology for Smart Grid Advanced metering infrastructure (AMI), home area network (HAN), neighborhood area network (NAN), wide area network (WAN). Bluetooth, zig-bee, GPS, Wi-Fi, Wi-Max based communication, wireless mesh network, basics of CLOUD Computing & cyber security for smart grid. Broad-band over power line (BPL). IP based protocols.	20

Text Books:

- Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley, 2010
- Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press, 2009
- S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
- Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press, 2008

Reference Books:

- Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", ArtechHouse Publishers July 2011
- R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System

Quality",2nd Edition, McGraw Hill Publication, 2002
- Yang Xiao, "Communication and Networking in Smart Grids", CRC Press, 2012

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the fundamental elements and structure of the smart grid.
CO2: Demonstrate the use of HAN, NAN, WAN for designing a smart grid.
CO3: Analyze communication, networking and sensing technologies involved with the smart grid.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3

BEEE 0034: POWER SYSTEM OPERATION & CONTROL

Objective: To expose the students to key concepts of operation and control of modern power system.

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Concept of energy control center (or) load dispatch centre and their functions, time-scale for various control problem. System hardware configuration – SCADA and EMS functions. State estimation. Various operating states of power system -Normal, alert, emergency, in-extremis and restorative states, state transition diagram. Contingency analysis and security assessment. **System load variation:** Load forecasting and simple techniques of forecasting. **Economic operation:** Unit commitment, Hydro-thermal scheduling – short term and long term. Derivation of transmission loss formula. **Automatic generation control (AGC):** Concept of automatic-generation/load-frequency and voltage control.	21
II	AGC of single area system – modeling of speed governing system and turbine modeling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, AGC and economic dispatch control. **AGC of two area system**: Modeling of two area system for AGC including tie line power flow. Block diagram and state-space representation of two-area system. Static and dynamic response. **Automatic voltage control:** Concept of voltage control - Schematic diagram and block diagram representation, modeling of Excitation system. Voltage and reactive power control: Methods of voltage control by tap changing transformer, shunt compensation, series compensation and phase angle compensation. **Flexible AC transmission systems:** Concept and objectives of FACT's controllers, structure and characteristics of FACT's controllers - TCR, FC-TCR, TSC, SVC, STATCOM, TSSC, TCSC, SSSC, TC-PAR, UPFC.	21

Text Books:

1. D.P. Kothari and I.J. Nagrath, "Modern Power System Analysis" Tata McGraw Hill, 4th edition.
2. P.S.R. Murty, "Operation and control in Power Systems" B.S. Publications.
3. A. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control "John Wiley & Sons.

References:

1. O.I. Elgerd, "Electric Energy System Theory" Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *Upon completion of this course, students will be able to*

CO1: Understand the modeling and control of single area and two area power system including the concept of AGC.
CO2: Calculate various factors including maximum demand, load factor, demand factor, diversity factor etc.
CO3: Apply the concept of AGC, AVC and FACT controllers in power system operation.
CO4: Analyze the performance of economic operation of interconnected thermal-thermal and hydro-thermal power systems.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO):

Cos	Pos/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO2
CO3	PO2, PO4, PO5, PSO3
CO4	PO2, PO3,PO4, PSO3

BEEE 0035: SWITCHGEAR AND PROTECTION

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Protection System:** Philosophy of protection, nature, causes and consequences of faults, requirements of a protective scheme, Basic terminology and components of protection scheme. Fuse, Isolators. **Relays:** Need for protective relaying,Protective Zones, Primary and back up protection, Properties of protective relaying, Relay classification, Principle and operation of electromagnetic and Induction type relay, Relay settings, Types of Relays; Directional, Distance, Differential, Over Current and earth fault relays, Buchholz relay, Harmonic resistant relay, **Static relays -** (amplitude and phase comparator), Numerical relay/IEDs (Intelligent Electronic Devices).	20
II	**Protection Schemes:** Protection of Feeders, Generator, Transformer and Transmission line. Bus Zone and Pilot protection. **Over Voltage Protection**: Spark gaps, Arresters, Surge absorbers. BIL, Insulation coordination, Grounding of Power System. **Circuit Breakers-I**: Theory of arc formation, properties of arc. Theories of arc Interruption, RRRV, Current chopping, Duties of switch-gear, Resistance switching. Construction and operation of Air CBs, Oil CBs, Single and Multi-break construction, Vacuum circuit breaker, SF_6 circuit breaker, D.C. circuit breaker. **Circuit Breakers-II**: Comparative merits and demerits of CBs, Application of CBs, Circuit breaker rating, Recent development in circuit breakers	20

Text Books:

1. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", 2nd Edition 2004, PHI.
2. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", 2nd Edition 2017, TMH.

References:

1. Bhavesh Bhalja, R.P.Maheshwari & Nilesh Chothani, " Protection & Switchgear", 2nd Edition 2018, Oxford university press
2. S. S. Rao, "Switchgear Protection and Power System", 14th Edition 2019, KhannaPublishers

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: *At the end of the course the students will be able to:*

1. *Understand the fundamental concept of protection philosophy, protective relays, BIL, insulation coordination and constructional features of SF6, Air, Oil and Vacuum circuit breakers.*
2. *Distinguish the characteristics of under voltage, over current, differential, distance relays and Lightning arrestors etc.*
3. *Evaluate the various PSM and TSM for desired speed, sensitivity and selectivity of protective relaying.*
4. *Analyze the various protective schemes, breaker ratings and RRRV, CC, resistance switching phenomenon of circuit breakers.*

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2,/ PSO1, PSO2
CO3	PO1, PO2/PSO1,
CO4	PO1, PO2/ PSO1, PSO2, PSO3

BEEE 0050: SENSORS AND TRANSDUCERS

Objective: *To make students familiar with the constructions and working principle of different types of sensors and transducers and their uses.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Mechanical and Electromechanical sensor**: Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. **Inductive sensor**: common types- Reluctance change type, Mutual inductance change type, transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input output variable, Ferromagnetic plunger type, short analysis. LVDT: Construction, material, output input relationship, I/O curve, discussion. Proximity sensor. **Capacitive sensors**: Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics. **Piezoelectric element**: piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors	21
II	**Thermal sensors**: Material expansion type: solid, liquid, gas & vapor Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification. **Thermoemf sensor**: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison. Pyroelectric type. **Magnetic sensors**: Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics. Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response. Geiger counters, Scintillation detectors, Introduction to smart sensors.	21

Text Books:

- Sensor & transducers, D. Patranabis, 2nd edition, PHI, 2003
- Instrument transducers, H.K.P. Neubert, Oxford University press, 1999
- Measurement systems: application & design, E.A.Doebelin, McGraw Hill, 1990

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the basic principle of Sensors and Transducers and their classifications
CO2: Explainthe working principle of Electrical, Thermal and Magnetic Sensors
CO3: Analyze the characteristics of different types of Transducers and Sensors
CO4: Distinguish among different types of Transducers and Sensors

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO3
CO3	PO1, PO2, PO3, PO4,/ PSO1,PSO2
CO4	PO1, PO2, PO3, PO4,/ PSO2, , PSO3

BEEE 0051: OPTIMAL CONTROL SYSTEMS

Objective: *To aware the students about Stochastic Optimal Linear Estimation, Control Stochastic processes and Microprocessor and DSP control Basic computer Architecture.*

Credits: 03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	General Mathematical Procedures: Formulation of the optimal control Problem, Calculus of variations, Minimum principle, Dynamic Programming, Numerical Solution of Two-point Boundary value problem. Optimal Feedback Control: Discrete-Time linear State regulator, Continuous-Time Linear state Regulator results to solve other linear problems, Suboptimal Linear regulators, Minimum-time Control of Linear Time-Invariant System, Stochastic Optimal Linear Estimation and Control, Stochastic processes and linear systems, Optimal Estimation for Linear Discrete time Systems, Stochastic Optimal Linear Regulator.	20
II	Microprocessor and DSP control Basic computer Architecture, Microprocessor Control of Control System, Single Board Controllers with Custom Designed Chips, Digital Signal Processors, Effect of finite World Length and Quantization on Controllability and Closed Loop–Pole Placement, Effects of Quantization, and Time Delays in Microprocessor Based control systems.	20

Text Books:

1. M. Gopal, "Modern Control Engineering", New Age International Publishers, 1996.
2. B.C. Kuo, "Automatic Control Systems", 10th Ed. McGraw Hill, 2017.

Reference Books:

1. Brain D.O. Anderson, John B. Moore, "Optimal control Linear Quadratic Methods", Prentice Hall of India Private Limited, 2000.
2. D. S. Naidu: Optimal Control Systems, CRC Press, 2002.
3. Sinha: Linear Systems: Optimal and Robust Control, CRC Press, 2007.
4. E. Bryson and Y-C Ho: Applied Optimal Control, Taylor and Francis, 1975.
5. P. Sage and C. C. White, III: Optimum Systems Control (2nd Ed.), Prentice Hall, 1977.
6. D. E. Kirk: Optimal Control Theory: An Introduction, Prentice Hall, 1970.
7. J. L. Crassidis and J. L. Junkins: Optimal Estimation of Dynamic Systems, CRC Press, 2004.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the Formulation of the optimal control Problem, Calculus of variations, Minimum principle, Pole Placement, Effects of Quantization, and Time Delays in Microprocessor Based control systems.

CO2: Analyze Microprocessor Control of Control System, Single Board Controllers with Custom Designed Chips, Digital Signal Processors.

CO3: Estimate optimality for Linear Discrete time Systems Stochastic, Optimal Linear Regulator

CO4: Design Discrete-Time linear State regulator, Continuous-Time Linear state Regulator results to solve other linear problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEE 0055: DIGITAL CONTROL SYSTEM

Objective: *The aim of the course is to present control theory that is relevant to the analysis and design of computer-controlled systems, with an emphasis on basic concepts and ideas.*

Credits: 04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	Basic control system, advantages of digital control and implementation problems, basic discrete time signals, Modeling of sample-hold circuit, pulse transfer function, solution of difference equation by z- Transform method. **Design of Digital Control Algorithms:** Steady state accuracy, transient response and frequency response specifications, digital compensator design using frequency response plots and root locus plots. **State Space Analysis and Design:** State space representation of digital control system, conversion of state variable models to transfer functions and vice versa, solution of state difference equations, controllability and observability, design of digital control system with state feedback.	22
II	**Stability of Discrete System:** Stability on the z-plane and Jury stability criterion, bilinear transformation, Routh stability criterion on rth plane. Lyapunov's Stability in the sense of Lyapunov, stability theorems for continuous and discrete systems, stability analysis using Lyapunov's method. **Optimal digital control :** Discrete Euler Lagrange equation, max. min. principle, different types of problems and their solutions.	21

Text Books:

- B.C.Kuo, "Digital Control System", Saunders College Publishing, 1991
- M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill, 2006

Reference Books:

- R.Leigh, "Applied Digital Control", Prentice Hall, International, 1985
- C.H. Houpis and G.B. Lamont, "Digital Control Systems :Theory, hardware, Software", McGraw Hill publications, 1992

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the basic sampling theorem to convert a continuous-time system into a discrete-time system (frequency and time domain techniques) and state space model
CO2: Demonstrate the optimal digital control algorithm
CO3: Determine the poles of a second-order system based on the system's transient response of discrete-time systems
CO4: Analyze the stability of a closed-loop of discrete time systems using R-H criterion and Lyapunov's method
CO5: Design the digital controller and compensator using root locus

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO1, PSO2, PSO3

BEEE 0056: PLC & SCADA

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**PLC Introduction:** Technical Definition, advantages, characteristics, Chronological Evolution, Types of PLC: Unitary, Modular, Small, Medium and Large. Block Diagram of PLC: Input/output (I/O) section, Processor Section, Power supply, Memory central Processing Unit: Processor Software / Executive Software, Multi-tasking, Languages, Ladder Language. **Bit Logic Instructions:** I/O Symbols, Numbering system of inputs and outputs, Program format, introduction to logic: Equivalent Ladder diagram of various logic gates, De Morgan theorem validation. **Timers and Counters:** Timer-on Delay, Timer off delay, Retentive and non-retentive timers. Format of a timer instruction. Operation of PLC Counter, Counter Parameters, Counters Instructions Overview Count up (CTU) Count down (CTD). **Advanced instructions:** Introduction: Comparison instructions, discussions on comparison instructions, "EQUAL" or "EQU" instruction, "NOT EQUAL" or "NEQ" instruction, "LESS THAN" or "LESS" instruction, "LESS THANOR EQUAL' or "LEQ" instruction, GREATER THAN" OR "GRT" instruction, "GREATER THAN OR EQUAL TO" or "GRO" instruction, "MASKED COMPARISON FOR EQUAL" or "MEQ" instruction, "LIMIT TEST" or "LIM" instruction.	23
II	**PLC input output (I/O) modules and power supply:** Classification of I/O, I/O system overview, practical I/O system and its mapping addressing local and expansion I/O, input-output systems, direct I/O, parallel I/O systems serial I/O systems. Sinking and sourcing. Discrete input module. Rectifier with filter, threshold detection, Isolation, logic section, specifications of discrete input module, types of analog input module, special input modules, analog output module, **SCADA: D**efinition and history of Supervisory Control and Data Acquisition, typical Architecture, Communication Requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA. SCADA Architecture(First generation-Monolithic, Second Generation-Distributed, Third generation Networked Architecture), SCADA systems in operation and control of interconnected power system,	19

Text Book:

1. "PLC and Industrial application", Madhu chhanda Mitra and Samarjit Sengupta, Pernram international pub. (Indian) Pvt. Ltd., 2011.
2. Ronald L Krutz, "Securing SCADA System", Wiley Publication

Reference Books:

1. Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 3rd Edition.
2. John W Webb, Ronald A Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning, New Delhi, 5th Edition.
3. Stuart A Boyer, "SCADA Supervisory Control and Data Acquisition", ISA, 4th Revised edition

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: After completion of the course, student shall be able to:

CO 1: Understand numbering system, structure of a PLC, SCADA system, Input/output modules interfacing, components such as power supply, memory etc.

CO 2: Design ladder programs for the problems related to timers and counters and develop the ladder diagrams for various Boolean expressions.

CO 3: Analyze the comparative analysis of instructions including equality and non-equalities.

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PSO2, PSO3

BEEE0074: COMPUTER AIDED ELECTRIC MACHINE DESIGN

Objective: To expose the students to the key concepts of design of Transformer as well as three-phase induction motors.

Credits: 3 **L-T-P-J:3-0-0-0**

Module	Content	Teaching Hour
I	**Introduction:** Design strategy: Iterative process, selection of design variables, checking of performance parameters. Advantages: Prediction of performance from physical dimensions of machine. **Single and Three-phase Transformer Design:** Output equation, selection of specific loadings. Main dimension of core and shell types of transformer. Transformer windings, concentric, spiral, crossover and disc types of windings; sandwich types coil for shell type transformers. Calculation of operating characteristics: winding, resistance, leakage reactance, voltage regulation, losses and efficiency and no load current, calculation of temperature rise and design of tank and tubes. **Computer Aided Design:** Selection of design variables and performance constraints, Development of flow chart for transformer design incorporating performance constraints.	21
II	**Three-phase Induction Motor Design:** Output equation, selection of specific loadings. **Stator Design**: Calculation of stator turns per phase, selection of shape and number of slots, slot dimensions, length of mean turn. Design of air gap length. **Rotor Design**: Rules for selection of number rotor slots, design of rotor bars and end rings for cage type of rotor. Design of turn per phase for slip ring type rotor. **Calculation of operating characteristics**: Calculation of iron loss and no-load current, Calculation of mmf for air gap, stator core, stator teeth and mmf for rotor core. Calculation for rotor resistance for cage type and slip ring type of motors. Calculation of leakage reactance, total standstill impedance, short circuit current and short circuit power factor. **Computer Aided Design:** Development of flow chart for three-phase InductionMotor design incorporating performance constraints, design conforming to standard frames.	21

Text Books:

1. A. K. Sawhney: Electrical Machine Design, Dhanpat Rai and Sons.
2. S.K. Sen:Principles of Electrical Machine Design with Computer Programs, Oxford and IBH Pub. Company.

Reference Books:

1. M.G. Say: The Performance and Design of Alternating Current Machines,Sir IsaacPitman and Sons and The English Language Book Society.

Focus: This course focuses on Employability aligned with all COs.

Course Outcome*: After completion of course student will be able to*

- CO1: Explain the design details of single, three-phase transformers and three-phase Induction Motor.
- CO2: Develop flow chart for transformer and Induction motor design incorporating performance constraints.
- CO3: Calculate the operating characteristics of transformer and three-phase Induction Motor.
- CO4: Design single, three-phase transformers and three-phase Induction Motor.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO):

Cos	Pos/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO2
CO3	PO2, PO4, PSO3
CO4	PO2, PO4, PO5,PSO3

BEEE 0094 : WIND ENERGY CONVERSION SYSTEM

Objective: *To make students familiar with the technology, grid integration and energy assessment for the wind energy conversion system.*

Credits: 03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**BASICS OF WIND ENERGY TECHNOLOGY** Wind statistics- Measurements and data Presentation, Historical developments, latest developments, Indian scenario and worldwide developments, present status and future trends. Wind turbine aerodynamics. **CHARACTERISTICS OF WIND ENERGY** Nature of atmospheric winds- Wind resource characteristics and assessment–Anemometry, speed frequency distribution, effect of height, wind rose, Weibull distribution, atmospheric turbulence, gust wind speed, effect of topography. effect of Reynolds's number, actuator disc, Betz coefficient, design of wind turbine blade, effect of stall and blade tip speed ratio and coefficient of torque. **WIND ENERGY CONVERSION SYSTEM (WECS)** Rotor Selection, Annual Energy Output, HAWT, VAWT, Rotor Design Considerations-Number of Blades, Blade Profile -2/3 Blades and Teetering, Coning-Upwind/Downwind, Power Regulation, Yaw System- Tower, Synchronous and Asynchronous Generators and Loads.	22
II	**VARIABLE SPEED SYSTEMS** Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequencysystems synchronous generator- DFIG- PMSG -Variable speed generators modeling- Variable speedvariable frequency schemes. **GRID CONNECTED SYSTEMS** Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of thepower system including modeling issue.	20

Text Books:

- Steve Parker, "Wind power", Gareth Stevens Publishing, 2004.
- Freris L.L., Wind Energy Conversion Systems, Prentice Hall 1990.

- Spera D.A., Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering, ASME Press, NY 1994.

Reference Books:

- L.L.Freris “Wind Energy conversion Systems”, Prentice Hall, 1990
- S.N.Bhadra, D.Kastha,S.Banerjee,”Wind Electrical Sytems”,Oxford University Press,2010.
- Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
- E.W.Golding “The generation of Electricity by wind power”, Redwood burn Ltd., Trowbridge,1976.
- N. Jenkins,” Wind Energy Technology” John Wiley & Sons,1997
- S.Heir “Grid Integration of WECS”, Wiley 1998.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:
CO1:Understand the existing Wind Energy Conversion System and wind energy potential and application of wind energy with case studies and its environmental impacts.
CO2: Understand the Grid connected system for Wind Energy Conversion System
CO3: Analyze the various aerodynamic loads and its design criterion on wind turbine system and the control mechanism of wind turbine.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO3 /PSO1, PSO2
CO2	PO1,PO2,PO3 /PSO1, PSO2
CO3	PO1,PO2,PO3 /PSO2, PSO3

BEEE 0870: ELECTRIC DRIVES LAB

Objective: *To develop a basic understanding and control of AC and DC machine using power electronic converters.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I&II	1. To study speed control of separately excited dc motor by varying armature voltage using single-phase fully controlled bridge converter. 2. To study speed control of separately excited dc motor using single-phase dual converter (Static Ward-Leonard Control). 3. To study speed control of separately excited dc motor by varying armature voltage using single phase half controlled bridge converter. 4. To study closed loop control of separately excited dc motor. 5. To study speed control of separately excited dc motor using MOSFET/IGBT chopper. 6. To study speed control of single-phase induction motor using single phase ac voltage controller. 7. To study speed control of three phase induction motor using three phase ac voltage controller. 8. To study speed control of three phase induction motor using three phase current source inverter. 9. To study speed control of three phase induction motor using three phase voltage source inverter. 10. To study speed control of three phase slip ring induction motor using static rotor resistance control using rectifier and chopper. **Simulation Based Experiments (using MATLAB/ Simulink)** 11. To study transient response of separately excited dc motor. 12. To study speed control of separately excited dc motor using single phase full / half controlled bridge converter in discontinuous and continuous current modes. 13. To study speed control of separately excited dc motor using chopper control in motoring and braking modes. 14. To study transient response of three phase induction motor. 15. To study speed control of three phase induction motor using (a) constant/V/F control (b) constant voltage and frequency control.	24

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *On successful completion of the program, the student will be able to:*

1. Articulate power electronics applications in control of speed, torque and other components of motor.
2. Simulate the transient response and speed control of DC and AC Machine.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3

BEEE0053: BIOMEDICAL INSTRUMENTATION

Objective: *The course is aimed at giving the students an understanding of the human physiology and the various kinds of measurements involved in it.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Brief description of cardiovascular, neuronal, respiratory and muscular systems and origin of bio-potential—action potential and resting potential **Bio-electrical signals:** (ECG, EEG, EMG, EOG & ERG) and their characteristics Different types of electrodes for the measurement of ECG, EEG & EMG signals; electrodes tissue interface; contact impedance and its effects. **Cardiovascular system measurements**: measurement of blood flow, volume of blood, cardiac rate, heart sound, hemoglobin, blood glucose **Neuromuscular system measurements:** of neuron potential & muscle potential **Respiratory system measurements:** measurement of CO_2& oxygen concentration in exhaled air.	**21**
II	**Prosthetics and Therapeutic devices:** artificial heart, artificial kidney, limb prosthetics cardiac pacemakers, defibrillators, ventilators, muscle stimulators, hearing and retinal implants. **Patient monitoring system:** X-ray machine-different types, basic components; intelligent monitoring system—CT scan, MRI, ultrasonography, thermography endoscopy. **Role of laser and microprocessor in health care** **Safety measures:** physiological effects of electricity, shock hazards	**21**

Text Book:

1. Geddes, L.A and Baker, L. E, Principles of Applied Biomedical Instrumentation, John Wiley & Sons (1989)

References:

1. Cromwell, L, Weibell, F.J and Pfeifer, E. A, Biomedical Instrumentation and Measurements, PHI (2003)
2. Khandpur, R. S, Handbook of Biomedical Instrumentation, 2nd Ed, Tata McGraw Hill (2008)
3. Webster, J. G, Medical Instrumentation-Applications and Design, 3rd Ed. Wiley India(2009)
4. Singh, M, Introduction to Medical Instrumentation, PHI Learning (2010)

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1. Understand the physiology of biomedical system, important body parameters and their implications.
CO2. Understand the working principle of patient monitoring system such as X-ray machine, CT scan, MRI, etc.
CO3. Demonstrate the application of ventilators, defibrillators in diagnostics and therapeutic area and modern technology in health care and safety measures.
CO4. Classify various bio-electric signals and the electrodes associated with them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2, PO5, PO6/ PSO1, PSO3
CO3	PO1, PO3, PO5, PO6/PSO2, PSO3
CO4	PO1,PO2, PO3/PSO1, PSO2, PSO3

BEEE0076: Electric Vehicles

Objective: *The objective of this is to introduces the concepts, principles, analysis and design of electric and hybrid electric vehicles*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Electric and Hybrid Electric Vehicles** Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains **Energy storage:** Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors **Power Electronic Converter:** Battery Charging Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, High-frequency transformer based	21
II	**Electric Propulsion** EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives **Design of Electric and Hybrid Electric Vehicles** Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design	21

Text Books:

1. Ali Emadi, "Advanced Electric Drive Vehicles" Published by CRC Press April 21, 2017

Reference Books:

1. John G. Hayes, G. Abas Goodarzi, "Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles" John Wiley & sons Publishers Ltd 2018
2. Mi.Chris, M. Abul Masrur, "Hybrid Electric Vehicles : Principles and Applications with Practical Perspectives" ,2nd Edition John Wiley & sons Publishers Ltd 2017.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1. Understand working of Electric Vehicles and its performance parameter
CO2.Model and Analyze the energy storage for EV and HEV application
CO2. Analyze different power converters topologies used for electric vehicle application
CO4. Develop the electric propulsion unit and its control for EV/HEV applications

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3

BEEE0090: Introduction to Renewable Energy Technologies

Credits: 03 **L-T-P-J:3-0-0-0**

Module	Content	Teaching hours
I	Introduction to world energy scenario, Renewable energy resources, Radiation, Solar Geometry, radiation models; Solar Thermal, Optical efficiency, thermal efficiency, concentrators, testing procedures. Introduction to thermal systems (flat plate collector), solar architecture, solar still, air heater, panel systems; Photovoltaic	20
II	Introduction to semiconductor physics, doping, P_N junction, Sola r cell and its I_V characteristics, PV systems components, design of a solar PV systems. Biomass, Biomass resources, wood composition, pyrolysis, gasifies, biogas, biodiesel, ethanol; Wind, Introduction, types of wind machines, Cp- λ curve &betz limits, wind recourse analysis; Systems, stand alone, grid connected, hybrid, system design; Hydro systems , Hydro resources, types of hydro turbine, small hydro systems; Other systems, Geothermal, wave energy, ocean energy.	22

TEXTBOOKS

1. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi, 1996
2. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, second edition, John Wiley, New York, 1991

REFERENCES

1. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000
2. D. D. Hall and R. P. Grover, Biomass Regenerable Energy, John Wiley, New York, 1987.
3. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986.
4. M. A. Green, Solar Cells, Prentice-Hall, Englewood Cliffs, 1982.

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: After the completion of this course, students shall be able to

CO1: Recognize the need of renewable energy technologies and their role in global energy demand.
CO2: Choose the conventional and non conventional energy sources.
CO3: Compare the resources and working mechanism for renewable energy sources.
CO4: Assess the resources for appropriate site selection for power generation.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO1, PSO2
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEE0100: Illumination Science & Engineering

Objective: *The course is aimed at giving the students an understanding of several kinds of lighting sources & systems and its electrical control.*

Credits:04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Importance of Lighting in Human Life:** Optical systems of human eye, Dependence of human activities on light, performance characteristics of human visual system, Radiant energy and visible spectrum, energy conversion to light, External factors of vision-visual acuity, contrast, sensitivity, time illuminance, colour, visual perception, optical radiation hazards, Good and bad effects of lighting & perfect level of illumination. **Lighting Systems:** Daylight, incandescent, electric discharge, fluorescent, arc lamps and lasers; Energy efficient lamps; Artificial lighting as substitute to natural light. **Light sources and their assets:** Laws of illumination, polar, curves, photometry, photocells. Environment and glare.General illumination design, Illumination levels, loss factors, lamp selection and maintenance, types of lamps, lamp fittings, Light control, design aspects of indoor and outdoor lighting	21
II	**Electrical Control of Light Sources:** Ballast, ignitors and dimmers for different types of lamps. Ability to control natural light, Production of light, physics of generation of light, Properties of light, Quantification & Measurement of Light, Luminaries, wiring, switching and control circuits. Interior lighting Design: Industrial, residential, office departmental stores, indoor stadium, theatre and hospitals. **Exterior lighting Design:** Flood, street, aviation and transport lighting, lighting for displays and signalling - neon signs, LED-LCD displays beacons and lighting for surveillance. Energy Conservation codes for lighting; lighting controls-daylight sensors and occupancy sensors; controller design. Special Features of Aesthetic Lighting	21

Text Book:

1. H. S. Mamak, “Book on Lighting”, Publisher International lighting Academy
2. Joseph B. Murdoch, “Illumination Engineering from Edison’s Lamp to Lasers” Publisher -York, PA: Visions Communications
3. M. A. Cayless, A. M. Marsden, “Lamps and Lighting”, Publisher-Butterworth-Heinemann(ISBN978-0-415-50308-2)
4. Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002
5. John Matthews Introduction to the Design and Analysis of Building Electrical Systems, Springer, 1993

Reference Books:

1. “BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting”, Manak Bhavan, New Delhi
2. D. C. Pritchard, “Lighting”, 4th Edition, Longman Scientific and Technical, ISBN 0-582-23422-0
3. “IES Lighting Handbook”, (Reference Volume 1984), Illuminating Engineering Society ofNorth America.
4. “IES Lighting Handbook”, (Application Volume 1987), Illuminating Engineering Society ofNorth America
5. IESNA lighting Handbook., Illuminating Engineering Society of North America 9th edition2000
6. Applied Illumination Engineering, Jack L. Lindsey FIES (Author), Scott C. Dunning PHD PECEM (Author) ,ISBN-13: 978-0824748098 ISBN-10: 0824748093, 3rd Edition.IS 3646: Part I: 1992, Code of practice for interior illumination.
7. Organic Light Emitting Diodes (OLEDs): Materials, Devices and Applications, Alastair Buckley,University of Sheffieid, UK, ISBN: 978-0-85709-425-4.

Focus: This course focuses on Employability aligned with all COs.

Outcome: *After completion of course, the student will be able to:*

CO1. Understand the concept of illumination, lighting systems, lighting sources and exterior security lighting systems.

CO2. Compare various lighting systems and their inherent properties working in the narrow range of wavelengths from 380 nm to 730 nm.
CO3. Compute various parameters of photometric light sources, laws of illumination, photometry etc.
CO4. Design modern lighting sources and controls for energy efficient lighting and a smart control drive circuit.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3/ PSO1
CO2	PO1, PO2, PO3, PO4, PO6/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PO6/PSO2
CO4	PO1,PO2,PO3, PO4, PO5, PO6, PO7/ PSO2, PSO3

BEEE0112: DIGITAL SIGNAL PROCESSING

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hour
I	Review of discrete time signals and systems, Sampling of CT signals: Periodic sampling, Frequency domain representation of sampling, Reconstruction of bandlimited signal from its samples, Discrete time processing of continuous time signals, Continuous discrete time signals, Changing the sampling rate using discrete time processing. Discrete time systems: Linear time invariant discrete time systems, Characterization of LTI systems. Transform domain representation of signals and systems: The discrete time Fourier transform, the frequency response, the transfer function, Discrete Fourier series, Discrete Fourier transform, Computation of DFT	21
II	Linear convolution using DFT, FFT Algorithms, Direct Computation of the DFT Radix-2 FFT algorithms, Gortezel Algorithm, Chirp Z-transform The z-transform, The region of convergence of z-transform Structures for discrete time systems: Block diagram and signal flow representation of constant coefficient, linear difference equation, Basic structures for IIR systems, Basic structures for FIR systems, Lattice structures, Effects of coefficient quantization, Effect of roundoff noise in digital filters, Zero-input limit cycles Filter design techniques: Design of discrete time IIR filters from continuous time filters, Design of FIR filters by windowing, Optimum approximation of FIR filters, Linear phase filters.	21

Text book:

1. Oppenheim & Schafer, "Digital Signal Processing" PH

References:

1. John G Prokias, Dimitris G Manolakis, "Digital Signal Processing", Pearson Education.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: After completion of course, the student will be able to:

1. *Understand the basic discrete-time signals and systems, concepts of continuous time sampling, convolution sum, impulse and frequency response concepts for linear, time-invariant (LTI) systems, difference equation realization of LTI systems and discrete-time Fourier transform and basic properties of these.*
2. *Compute Discrete Time Fourier Transform, Discrete Fourier Series and Discrete Fourier Transform, linear convolution using DFT. FFT algorithms, z- Transform and its region of Convergence, etc.*
3. *Analyze the effects of coefficient quantization, round-off noise in digital filters and limit cycles.*
4. *Build discrete time system structures for IIR and FIR systems such as Direct-I, Direct-II, lattice structures, etc.*
5. *Design discrete time IIR and FIR filters using different approaches.*

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PO5/ PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PO5/ PSO2, PSO3
CO5	PO1, PO2, PO3, PO4, PO5/ PSO2, PSO3

BEEO 0092: NON CONVENTIONAL ENERGY RESOURCES

Open electives offered by EE dept. for ME, CS, EC & CE

Credits: 04 **L–T–P-J: 4–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction Various non-conventional energy resources-** Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. solar cell materials, solar cell power plant, limitations. **Solar Thermal Energy:** Solar radiation flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **Geothermal Energy:** Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.	20
II	**Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations. Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations. Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. **Wind Energy:** Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems. **Bio-mass:** Availability of bio-mass and its conversion theory. **Ocean Thermal Energy Conversion (OTEC)**: Availability, theory and working principle, performance and limitations. **Wave and Tidal Wave**: Principle of working, performance and limitations. Waste Recycling Plants.	20

Text Book:

1. B. H. Khan "Non-Conventional Energy resource" second edition Tata McGraw-Hill Education Private Ltd.

References Books:

1. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
2. F.R. the MITTRE, "Wind Machines" by Energy Resources and Environmental Series.
3. Frank Kreith, "Solar Energy Hand Book".

Focus: This course focuses on Employability aligned with COs.

Outcomes: *On successful completion of the program, the students will be able to*

- *CO1: Explain the need of green energy sources across the domains.*
- *CO2: Compare the resources and working mechanism of various renewable energy techniques.*
- *CO3: Acquired skills in the scientific and technological communications, and in the preparation, planning and implementation of energy projects.*
- *CO4: Analysis and design of renewable energy source for a site.*

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO1, PSO2
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEE0037: COMPUTER METHODS IN POWER SYSTEMS

Objective: *To introduce computer applications in the analysis of power systems and to understand the solution methods and techniques used in power system studies.*

Prerequisite: Power System Analysis (BEEC0013)

Credits: 04 **Semester VII** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Topological Analysis of Power Networks:** Introduction, Primitive Impedance and Admittance Matrices, System Graph for Transmission Network, Transmission Network Representations, Network Matrices, Network Reduction. **AC Power Flow analysis:** Power Flow Equations, Gauss-Seidel Method, Newton Raphson Load Flow Method, Decoupled and Fast Decoupled Load Flow Method. **Optimum Power Flow:** Classical Method of Economic Load Dispatch with and without Considering Losses, Derivation of Loss-Formula, Optimal Power Flow.	20
II	**Fault Analysis in Large Power System:** Introduction, Formulation of Z_{BUS} Types of Faults, Symmetrical and Asymmetrical Faults, Short Circuit Analysis in a Large PowerSystems using Z_{BUS}, Analysis of Open Circuit faults. **Security Analysis:** Introduction, static security analysis, concept of linear sensitivity factors: Generation outage sensitivity factor (GOSF), Line outage sensitivity factor (LOSF), DC Load Flow, Contingency Analysis, Analysis of multiple contingencies, Contingency ranking and selection. **Stability Analysis:** Classification of power system stability, equation of motion of a synchronous generator, Representation of Generators and loads for transient stability analysis, Transient stability analysis of Multi-Machine Systems.	20

Text Book:

- G.W. Stagg & A.H. El-Abiad,'Computer Methods in Power System Analysis', Mc-Graw Hill, 1988.
- Haadi Saadat, 'Power System Analysis', Mc-Graw Hill, 2010.

References:

- John J. Grainger and William D. Stevenson Jr., 'Power System Analysis', Mc-Graw Hill, 2011.
- M A Pai and Dheeman Chatterjee, 'Computer Techniques in Power System Analysis', Mc-Graw Hill, 2017.
- A.R. Bergen and Vijay Vittal, 'Power Systems Analysis',Pearson Education Asia, 2001.
- J.D. Glover, M. Sharma and T.J. Overbye, 'Power SystemAnalysis and Design', Fourth Edition, ThomsonEngineering Press, 2008.

Focus: This course focuses on Employability aligned with all COs.

Outcome: *On successful completion of the program, the student will be able to:*

1. *Understand the modeling issues and analysis methods for the power flow, short circuit, contingency and stability analysis, required to be carried out for the power systems.*
2. *Determine the operating conditions of a system according to the demand without violating the technical and economic constraints.*
3. *Evaluate the effect of outage of any important component of power system on the operation and reliability of power systems.*
4. *Analyze the solution methods used in power system studies.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PSO1
CO2	PO1, PO2, PO3, PSO3
CO3	PO1, PO2, PO3, PSO3
CO4	PO2, PO3, PO4, PSO3

BEEE0099: Design and Installation of Solar PV System

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	Overview of Photovoltaics, Photovoltaic Electric Principles, The Solar Resource. , Electric Load Analysis. , Photovoltaic Modules, Batteries. PV Controllers, Inverters, Photovoltaic System Wiring, Sizing Stand-alone Photovoltaic Systems.	14
II	Grid-tied Photovoltaic, Systems, Mounting Photovoltaic Modules. Photovoltaic Applications for the Developing World, Photovoltaic System Installation, Maintenance and Troubleshooting, Safety and PV Installation.	14

Text Book:

1. Chetan Singh SolankiSolar Photovoltaics: Fundamentals, Technologies And Applications 3rd Edition, Kindle Edition
2. A Design Handbook for Architects and Engineers International Energy Agency, Paris, France Principal Editors: Friedrich Sick Thomas ErgeFraunhofer Institute for Solar Energy Systems (FhG-ISE) Freiburg, German Publishing Company.

Reference Books:

1. Chetan Singh Solanki "Solar Photovoltaic Technology and Systems": A Manual for Technicians,Trainers and Engineers Kindle Edition, PHI 2016

Outcomes: Students will be able to -

1: Critically assess solar photovoltaic system applications in the benefit of society.
2: Analyze solar photovoltaic system energy and building resources.
3: Design of solar photovoltaic systems.
4: Evaluate the performance with maintenance of faults in the system.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO1, PSO2
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEJ0986: Project Based on Design and Installation of solar PV system

Credits: 2 **L-T-P-J: 0-0-0-8**

List of Projects

1. Development of models for Solar resources monitoring and assessment on hourly basis
   In this projects students use Pyranometer for real time solar radiation measurement then based on used data set new approaches will be developed for forecasting the solar radiation.

2. Control strategy for self-healing of the off grid system
   In the current scenario of increased application of off grid solar PV system, its self-healing is important for the stability as well as maximum utilization to achieve high PR value

3. Policies for maximizing the skilled human resource
   To cooperate with the government initiative, based on regional requirement policies can be developed by the students to train the people of same area

4. Solar PV array fed induction motor for pumping applications at large level

5. Analysis of risk factor involves in solar projects funding and their mitigation

6. Solar PV Array fed indirect vector control of induction motor for pumping applications

7. Power Quality issues due to solar integration in GLA university Mathura distribution system.

8. Solar irradiance prediction using deep learning

*__The project list can change as per the industry requirement__

BEEE00852: COMPUTER METHODS IN POWER SYSTEMS LAB

Objective: *To introduce computer applications in the analysis of power systems and to understand the solution methods and techniques used in power system studies.*

Pre/Co-Requisite: Power System Analysis (BEEC0013)/BEEE0037

Credits: 01 **L–T–P: 0–0–2**

Module No.	Contents	Lab Hours
I,II	MATLAB/ETAP Based Experiments - 1. To formulate Y Bus matrix for a given power system. 2. To formulate Z Bus matrix for a given power system. 3. To perform the load flow analysis using Gauss Seidel Method. 4. To perform the load flow analysis using Newton-Raphson Method. 5. To perform the load flow analysis using Fast Decoupled Method. 6. To perform optimal load dispatch of generators using analytical and graphical method. 7. To obtain the equations describing the motion of the rotor angle and the generator frequency for a given power system. 8. Determine the critical clearing angle and the critical fault clearing time when a 3-phase fault occurs at the sending end of the line. 9. Determine the critical clearing angle and the critical fault clearing time when a 3-phase fault occurs at the middle of the line. 10. To conduct short circuit analysis for a given power system. 11. To carry out security analysis for a given power system.	24

Focus: This course focuses on Employability aligned with all COs.
Outcome: *On successful completion of the program, the student will be able to:*

1. *Implement the algorithms required to find out parameters for monitoring and control of power system in real time from actual measurement data.*
2. *Apply computer algorithms, used to solve algebro-differential pertaining to power system, to assess the stability performance of power systems in MATLAB/ETAP environment.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO3
CO2	PO2, PO3, PO4, PSO2

BEEE 0072: ELECTRIC DRIVES

Objectives:

- To learn the fundamental concepts of dynamics and control of Electric Drives.
- To study the criterion for selection of drives for various applications.
- To study the traditional methods of speed control.
- To learn the static control of DC and AC Drives.

Credits: 03 **L–T–P-J: 3–0–0-0**

Module	Content	Teaching Hour
I	**Types of Drives and Loads**: Classification of electric drives, comparison with other types of drives. Characteristics of different types of mechanical loads, stability of motor-load systems. **Selection of Motor Power Rating:** Thermal loading of motors, estimation of motor ratings for continuous, intermittent and short time duty loads. Fluctuating loads and load equalization. **Classical Methods of speed control:** Speed control of d.c. motors: rheostatic, field and armature control methods. Speed control of induction motors: stator voltage control, frequency control, pole changing and rotor resistance control methods. **Static Control of D.C. Drives**: Phase control of fully controlled dc drives: continuous and discontinuous conduction modes of operation.	21
II	Chopper controlled drives: TRC and CLC controls, continuous, discontinuous and critical conduction modes of operation. Closed loop control of d.c. drives: phase and chopper controlled drives. Electric braking of d.c. drives. **Static Control of A.C. Drives**: Static stator voltage control, variable frequency Constant volts/Hertz control, slip power recovery schemes. Method of voltage injection in rotor circuit. Introduction to vector control. Closed loop control of induction motor drives: VSI control, static rotor resistance control, Electric braking of induction motor drives.	20

Text Book:

1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House New Delhi, 2010.
2. S. K. Pillai, "A First Course on Electric Drives", New Age Publication 2012.

Reference Books:

1. Vedam Subrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill 2010.
2. Bimal K. Bose, "Modern Power Electronics and A.C. Drives", Pearson Education, India 2003.
3. Joseph Vithayathil, " Power Electronics, Principles and Applications", McGraw Hill, Inc 2010.
4. R. Krishnan," Electric Motor & Drives: Modeling, Analysis & Control, PHI Pvt. Ltd. 2001.

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: After learning the course the students should be able to:

CO1: Understand the basics of Speed–torque characteristics of electrical machines, static devices, and closed-loop control.
CO2: Compute the thermal heating and cooling time constants of electric drives.
CO3: Analyze the static control of DC and AC drives; and electric braking of drives.
CO4: Design the phase-controlled, chopper-controlled, and closed-loop controller of DC and induction motor drives.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, / PSO1
CO2	PO1, PO2/ PSO1, PSO2
CO3	PO1, PO2, PO3, /PSO2, PSO3
CO4	PO1, PO2, PO3/ PSO2, PSO3

BEEJ0966: Electric Vehicles Project

Objective: The objective of the project is to develop the analysis and design of electric and hybrid electric vehicles in any of one domain mentioned in the list.

Credits:02 **L-T-P-J:0-0-0-8**

Module No.	Content	Teaching Hours
I	**Student may choose any project from the mentioned domain:** **1.** Modelling of a Hybrid Electric Vehicle using ADVISOR ADVISOR can be used for the analysis of performance, fuel economy, and emissions of conventional, electric, hybrid electric, and fuel cell vehicles. The backbone of the ADVISOR model is the Simulink block diagram. In the project student will model and simulate the performance of different hybrid energy sources for hybrid vehicle. **2.** Control Strategy of Hybrid Fuel Cell Power System Fuel cell is used as main source in electric vehicle. This project will focus on control strategy of fuel cell for steady state load current at load transient. **3.** Electric Rikshaw Range Modelling The project will focus on modelling & simulation of range for the commercially available E-Riakshaw and compare the results with E-Rikshaw available with GLA University. **4.** Modelling of Transmission System In HEV, the transmission system perform the task which controls the direction and amount of power flow on the vehicle so as the overall efficiency of a hybrid vehicle is improved. The project will focus the modelling of transmission system in MATLAB.	24

Focus: This course focuses on Employability aligned with COs.

Outcome: After completion of course, the student will be able to:

CO1: Model and Analyze the various components used in EV/HEV

CO2: Analyze the performance of vehicle

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3

BEEE0851: INTELLIGENT TECHNIQUESIN ELECTRICAL ENGINEERING LAB

Objective: *To develop a basic understanding of Artificial intelligence techniques, and their applications to Electrical Engineering and to provide motivation to design intelligent systems and control. Computer simulation of intelligent control systems to evaluate the system performance.*

Pre/Co-Requisite:*BEEE0036*

Credits: 01 **L–T–P: 0–0–2**

Module No.	Contents	Lab Hours
I	1. To study MATLAB tools for Neural Networks. 2. To study MATLAB tools for Fuzzy Logic. 3. To study MATLAB tools for Genetic Algorithm. 4. Training algorithms of neural networks and fuzzy logic 5. Implementation of fuzzy logic, Neural networks and genetic algorithms on various applications.	24

Focus: This course focuses on Employability aligned with all COs.
Outcome: *On successful completion of the program, the student will be able to:*

1. *Implement neural networks and fuzzy logic for classification, control system and optimization problems.*
2. *Simulate the fuzzy controllers using intelligent algorithms in MATLAB environment.*
3. *Obtain the optimum solution of well formulated optimization problem using Genetic Algorithm.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PSO2
CO2	PO1, PO2, PO3, PSO2
CO3	PO1, PO2, PO3, PO5, PSO3

BEEE0036: INTELLIGENT TECHNIQUESIN ELECTRICAL ENGINEERING

Objective: *To develop a basic understanding of Artificial intelligence techniques, and their applications to Electrical Engineering and to provide motivation to design intelligent systems and control.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Motivation, Rationale for using Artificial Intelligence (Neural Network, Fuzzy, Evolutionary Computation) in Engineering. **Artificial Neural Network:**Concept of Artificial Neural Networks (ANN), Adaline, Linear Separable Patterns, Single Layer Perceptron, Multilayer Perceptron,Neural Network (NN) architecture, NN Classifications, Back Propagation Algorithm, Radial Basis Function Network (RBFNN), Applications of ANN. **Fuzzy Logic**:Introduction, Classical Sets, Classical Sets Operations, Properties of Classical Sets, Fuzzy Sets, Fuzzy Membership Functions, Fuzzy Set Operations, Properties of Fuzzy Sets, Alpha-Cut Fuzzy Sets, Extension Principle.	21
II	**Fuzzy Logic:**Fuzzy Measures, Measures of Fuzziness, Classical Relations vs. Fuzzy Relations, Predicate Logic, Fuzzy Logic, Approximate Reasoning, Fuzzy Rule Based System, Fuzzy Logic Controller, Applications of Fuzzy Logic. **Evolutionary Computation:** Introduction to Evolutionary algorithms, Genetic Algorithm (GA), solution, initial population, genetic operators, fitness function, stopping condition, fitness scaling, rank scaling, proportional scaling, top scaling, selection, Roulette Wheel selection, stochastic universal sampling, rank selection, tournament selection, other selection methods, mutation, uniform mutation, Gaussian mutation, variable mutation rate, crossover techniques, other genetic operators, Generation Gap, Elitism, Duplicates, Genetic Search, Genetic Programming, Applications of GA.	21

Text Book:

- Ali Zilouchian, Mo Jamshidi, "Intelligent control systems using soft computing methodologies", CRC Press, 2001.
- James M. Keller, Derong Liu, David B. Fogel, "Fundamentals of Computational Intelligence. Neural Networks, Fuzzy Systems, and Evolutionary Computation", Wiley, 2016.
- Chennakesava R. Alavala, "Fuzzy Logic and Neural Networks-Basic Concepts and Applications" New Age Publications (Academic), 2008.

Reference Book:

- Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India, 2010.
- AnupamShukla, RituTiwari, Rahul Kala, "Real Life Applications of Soft Computing", CRC Press, T & F Group, 2010.
- Kevin M. Passino and Stephen Yurkovich, "Fuzzy Control", Addison Wesley Longman, Menlo Park, CA, 1998.
- Kevin Warwick, Arthur Ekwue and Raj Aggarwal, "Artificial Intelligence Techniques in Power Systems", Institution of Engineering and Technology, London, UK, 1997.

Focus: This course focuses on Employability aligned with all CO3, CO4 and CO5.
Outcome: *On successful completion of the program, the student will be able to:*

1. *Understand the basics of Neural Network, Fuzzy and Evolutionary Computation.*
2. *Apply the neural networks for classification, control system and optimization problems.*
3. *Analyze the performance of optimization problem using Genetic Algorithm.*
4. *Design intelligent controllers for the given problem.*

5. *Formulate intelligent algorithms for typical electrical applications.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PSO1
CO2	PO1, PO2, PSO2
CO3	PO2, PO3, PSO3
CO4	PO3, PO4, PSO3
CO5	PSO3, PO3, PO5

BEEE0071: SPECIAL ELECTRIC MACHINES

Objective: *To make the student able to understand the constructional and operational working of the Single phase synchronous motor, stepper motor, two phase AC servomotor, single phase commutator Motors and linear induction motor.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Single Phase Synchronous Motor:** Construction, principle of operation and characteristics of: reluctance motors, hysteresis motors, switched reluctance motors. **Stepper Motors:** Construction and principle of operation of: variable reluctance, permanent magnet and hybrid stepper motors. **Permanent Magnet Machines:** Permanent magnet ac and dc motors: brushless dc motors and their important features and applications, PCB motors, introduction to permanent magnet generators.	21
II	**Two-Phase AC Servomotors:** Construction, torque-speed characteristic, performance and applications. **Single-Phase Commutator Motors**: Construction, principle of operation and applications of: universal motor, single phase a.c. series motor, repulsion motors. **Principle of voltage injection:** Principle of voltage injection in rotor circuit of slip ring induction motor: Schrage Motor. **Linear motors**: Construction and principle of operation of Linear induction motors.	21

Text Books:

1. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill.
2. J.B.Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons.
3. AshfaqHussain, "*Electric Machines*", Dhanpatrai and Sons.

Reference Books:

1. PenshawTaylor, "The Performanceand Design of A.C. Commutator Motors", A.H.Wheeler& Co.
2. Cyril G. Veinott , "Fractional and Sub-fractional horse power electric motors", McGraw Hill.
3. M.G. Say, "*The Performance and Design of AC machines*", Pit man & Sons.
4. A.E. Fitzgerald, C.KingsleyandUmans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill.
5. F.Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating CurrentMachines*", Asia Publishing House.

Focus: This course focuses on Employability aligned with all CO2, CO3 and CO4.

Outcome: After completion of course, the student will be able to:

1. *Understand the working principle of hysteresis motors, PCB motor,* permanent magnet generators *repulsion motor and linear induction motor.*
2. *Analyze the concept of speed control of permanent magnet dc motor, universal motor and Schrage motor.*
3. *Compute the various type of performance parameters of reluctance motor, stepper motors, permanent magnet dc motor, brushless dc motors and two-phase AC servomotor.*
4. *Apply concept of voltage injection method in 3 phase induction motor.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEE 0078: UTILIZATION OF ELECTRIC POWER & TRACTION

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Illumination engineering:** Nature of light, general terms used in illumination, sensitivity of the eye, production of light, incandescent lamps, arc lamps, gas discharge lamps-fluorescent lamps, comparison of magnetic and electronic ballast circuit, polar curves. Distribution and control of light, solid angle, inverse square and cosine laws, lighting calculations, methods of calculations, factory lighting, flood lighting and street lighting. **Refrigeration:** Electrical circuits used in domestic refrigerator. **Electrolysis:** Review of electrolytic principles, laws of electrolysis, current efficiency, energy efficiency, electrode position, anodizing, electroplating , extraction of metals, refining of metals. **Electric heating:** Electrical heating advantages, methods and applications, resistance heating, design of heating elements, induction heating, core type furnaces, core less furnaces and high frequency eddy current heating, dielectric heating, arc furnaces (direct arc furnaces, Indirect arc furnaces), electrodes, power supply and control.	21
II	**Welding:** Different methods of electrical welding, resistance welding, arc welding, laser welding, electron-beam welding and welding transformers. **Traction system:** Different system of electric traction and their advantages and disadvantages, Special features of traction motors, selection of traction motor, mechanics of train movement, simplified speed time curves for train movement, crest, average and schedule speed, tractive effort, specific energy consumption, adhesive weight and coefficient of adhesion. **Power supply for electric traction:** Conductor rail system, bow collector, pantograph collector, main parts of AC electric locomotive unit, use of boosters to minimize interference with communication lines **Applications:** Tramways, trolley bus, diesel electric traction.	21

Text Books:

1. H.Partab,"Art and Science of Electrical Energy" DhanpatRai& Sons publications.
2. J. B. Gupta, "Electrical Power Utilization" S.K.Kataria& Sons publication.

Reference Books:

1. S. Sivanagaraju, M. Balasubba Reddy & D. Srilatha, "Generation and Utilization of Electrical Energy", Pearson Publications.
2. N.V. Suryanarayana,"Utilization of Electric Power" Wiley Eastern publication.

Focus: This course focuses on Employability aligned with all COs.

Outcome: *After completion of course, student will be able to:*

CO1: *Explain application of electric power in Illumination, refrigeration, electrolysis, heating, welding and traction system.*

CO2: *Compare electrical characteristics of different illumines, heating and welding schemes*

CO3: *Analyze role of speed-time curves, tractive effort, specific energy consumption and power supply for an electric traction system*

CO4: *Design a heating element and lighting scheme for a given application*

CO5: *select a suitable motor for traction application*

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO1, PSO2, PSO3

BEEG0002/BEEE: ELECTRICAL TECHNOLOGY

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Power Generation** Power generation scenario in India, conventional generation and plant layout: Hydroelectric power generation, thermal power generation, Nuclear power generation, comparison. Renewable generation and system layout: photovoltaic generation, wind power, tidal power, geothermal power, fuel cell. Load curves, Important terms and factors: connected load, maximum demand, average load, load factor, diversity factor. **Economics of power generation:** fixed cost, semi fixed cost, running cost, Tariff: objective, desirable characteristics, types.	21
II	**Transmission and distribution:** Electric supply system layout, introduction to ac and dc transmission system, comparison, elements of transmission: power transformer, towers, insulators, conductors, cables, distribution transformer; requirements of satisfactory electric supply, overview of distribution system, challenges in power system. **Power factor improvement:** Power triangle, disadvantages of low power factor, causes of low power factor, power factor improvement method, calculation for power factor correction **Electrical loads:** Modelling of load, Electric lighting: Basic parameter used in lighting, various types of lighting sources: Fluorescent lamps, electrical circuitry, CFLs, LED lighting, Lighting design process, Electric Motor: load characteristics, gearing, various applications such as elevator, hybrid electric vehicle (HEV). Introduction to transducers and sensors.	22

Text Books:

1. Mehta V.K. & Mehta Rohit. Principles of Power System (Multicolor Edition).S. Chand, 2005 (illustrated, revised edition).
2. Gross, Charles A., and Thaddeus A. Roppel. Fundamentals of electrical engineering. CRC press, 2012.

Reference Books:

1. Bird, John. Electrical circuit theory and technology. Routledge, 2017
2. Hughes, Edward, et al. Hughes electrical and electronic technology. Pearson education, 2008.

Focus: This course focuses on Employability aligned with all COs.

Course Outcome: *at the end of course student will able to,*
CO1: Elaborate and compare conventional and renewable energy power generation.
CO2: Understand the terms as used in load curves.
CO3: Estimate cost of power generation and tariffs.
CO4: Identify role of various components involved in transmission and distribution of electrical power.
CO5: Understand the importance of power factor improvement.

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO1, PSO3

BEEC0011: CONTROL SYSTEM

Credits: 4 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**The Control System:** Open loop & closed control, Servomechanism, Control System Physical examples. Transfer functions, Block diagram algebra, Signal flow graph, Mason's gain formula **Control System Components:** Constructional and working concept of ac servomotor, synchro. **Time Response analysis:** Time response of first and second order systems, time response specifications, steady state errors and error constants **Controller:** PID controller, performance indices, **Stability in Time Domain:** Concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations.	22
II	**Root Locus Technique:** The root locus concepts, construction of Root Loci **Frequency Response Analysis:** Frequency response, correlation between time and frequency responses. **Frequency Response Analysis:** Polar plots, Bode plots **Stability in Frequency Domain**: Nyquist stability criterion, assessment of relative stability, gain margin and phase margin **Introduction to Design:** The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in frequency domain**.** **Overview of State Variable Technique**. Overview of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability.	22

Text Books:
1. Nagrath I. J. &Gopal M, *"Control System Engineering"*, New age International. 6th edition (2017).
2. K. Ogata, "*Modern Control Engineering"*, Prentice Hall of India. 5th edition (2010)

References:
1. Norman S. Nise, *"Control System Engineering",* Wiley Publishing Co. 8th edition (2019).
2. A. Anand Kumar, *"Control systems",* PHI learning private limited, 2nd Edition (2014)
3. B.C. Kuo & M. F. Golnaraghi, "*Automatic Control System"*, Wiley India Ltd. 8th edition (2007)

Focus: This course focuses on Employability aligned with all COs.

Outcome: *After completion of course, students will be able to:*

CO1. Explain the meaning of control system, its types as well as treatment of special control system.

CO2. Solve the transfer functions of physical systems using block diagram reduction method or signal flow graph approach.

CO3. Understand time response and frequency response analysis and stability aspects of a system.

CO4. Implement different numerical and graphical stability technique to analyze the stability of control system.

CO5. Understand the overview and importance of time domain approach such as state variable technique in control system analysis.

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1,
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO1
CO5	PO1, PO2, PO3, PO4 /PSO1, PSO3

COURSE STRUCTURE

B. TECH.
ELECTRICAL & ELECTRONICS ENGINEERING

Under
Choice Based Credit System (CBCS)

Batch 2020-24

PROGRAM STRUCTURE
EE-1100

Sr. No.	Categorization	Credits
1	Humanities & Social Sciences	25
2	Basic Sciences	24
3	Engineering Sciences	28
4	Project Work / Seminars	17
5	Program Core	48
6	Program Electives	26
7	Open Electives	16
8	Non Graded Mandatory Courses	8(2 credits in each sem.)
	Total Credits	186/192(Including MNC)

Project Work / Seminars	Mini Project	4 = (1+3)
	Industrial Training	2
	Minor Project	3
	Major Project	8

SEMESTER I

SR. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	CONTACT HRS/WK
1.	BMAS0101	Engineering Mathematics – I	3	1	0	4	4
2.	BELH0001	English Language Skills For Communication I	1	2	0	2	3
3.	BPHS0001	Engineering Physics	3	1	0	4	4
4.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
5.	BEEG1001	Basic Electrical Engineering	3	1	0	4	4
		PRACTICALS					
6.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
7.	BMEG0801	Engineering Drawing	0	0	2	1	2
8.	BEEG0801	Electrical Simulation Lab	0	0	4	2	4
9.	BELH0801	English Language Lab I	0	0	2	1	2
10.	BMEG0801 /BMEG0800	Engineering Drawing/Workshop Practice Lab	0	0	2	1	2
11.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
		Total	**15**	**6**	**14**	**25**	**33**

SEMESTER II

SR. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	CONTACT HRS/WK
1.	**BMAS 0102**	Engineering Mathematics – II	2	0	0	4	2
2.	BELH 0002	English Language Skills For Communication – II	1	2	0	2	3
3.	BCHS 0101	Engineering Chemistry	3	1	0	4	3
4.	BCSC 0001	Computer Programming	3	2	0	5	4
5.	BECG 0001	Electronics Engineering	3	1	0	4	4
6.	BEEG 0002	Electrical Technology	3	0	0	3	3
		PRACTICALS					
7.	BEEG 0802	Electrical technology Lab	0	0	2	1	2
8.	BECG 0800	Electronics Lab – I	0	0	2	1	2
9.	BCSC 0800	Computer programming lab	0	0	2	1	4
10.	BELH 0802	English Language Lab – II	0	0	2	1	2
11.	BCHS 0801	Engineering Chemistry Lab	0	0	2	1	2
		TOTAL	15	1	10	27	34

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/Co-REQUISITES
			L	T	P	J			
		THEORY							
1	BEEC0003	Engineering Circuit Analysis & Synthesis	3	0	0	0	3	3	-
2	BEEC0004	Electrical Measurement & Measuring Instruments	3	0	0	0	3	3	-
3	BEEC0005	Field Theory & Applications	3	0	0	0	3	3	-
4	BEEC0016	Signals & Systems	3	0	0	0	3	3	-
5	BEEC0007	Analog Integrated Circuit	3	0	0	0	3	3	-
6	BEEC0008	Digital Electronics & Circuits	3	0	0	0	3	3	-
7	BEEC0009	Electrical Machines – I	3	0	0	0	3	3	
8	BEEC0010	Electrical Machines – II	3	0	0	0	3	3	
9	BEEC0011	Control System	3	0	0	0	3	3	
10	BEEC0017	Power System Transmission & Distribution	3	0	0	0	3	3	
11	BEEC0018	Power System Analysis & Protection	3	0	0	0	3	3	
12	BEEC0014	Power Electronics	3	0	0	0	3	3	
13	BEEC0015	Microprocessor & Its Applications	3	0	0	0	3	3	
		PRACTICAL							
14	BEEC0803	Network Lab	0	0	2	0	1	2	BEEC0003
15	BEEC0804	Electrical Measurement Lab	0	0	2	0	1	2	BEEC0004
16	BEEC0805	Analog & Digital Electronics Lab	0	0	2	0	1	2	BEEC0008
17	BEEC0806	Electrical Machines Lab – I	0	0	2	0	1	2	BEEC0009
18	BEEC0807	Electrical Machines Lab – II	0	0	2	0	1	2	BEEC0010
19	BEEC0808	Control System Lab	0	0	2	0	1	2	BEEC0011
20	BEEC0812	Power Systems & Protection Lab	0	0	2	0	1	2	BEEC0013
21	BEEC0810	Power Electronics Lab	0	0	2	0	1	2	BEEC0014
22	BEEC0811	Microprocessor Lab	0	0	2	0	1	2	BEEC0015
		Total	**39**	**0**	**18**	**0**	**48**	**57**	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Power System & Machines									
THEORY									
1.	BEEE0030	Electrical Power Generation	3	0	0	0	3	3	
2.	BEEE0036	Intelligent Techniques In Electrical Engineering	3	0	0	0	3	3	
3.	BEEE0034	Power System Operation & Control	3	1	0	0	4	4	
4.	BEEE0031	High Voltage Engineering	4	0	0	0	4	4	
5.	BEEE0032	Smart Grid	3	0	0	0	3	3	
6.	BEEE0072	Electric Drives	3	0	0	0	3	3	
7.	BEEE0071	Special electric Machines	3	0	0	0	3	3	
8.	BEEE0078	utilization of electric power & traction	3	1	0	0	4	4	
9.	BEEE0076	Electric Vehicles	3	1	0	0	4	4	
PRACTICALS									
10.	BEEE0851	Intelligent Techniques In Electrical Engineering Lab	0	0	2	0	1	2	BEEE 0036
11.	BEEE0870	Electric Drives Lab	0	0	2	0	1	2	BEEE0072
PROJECTS									
12.	BEEJ0966	Electric Vehicles Project	0	0	0	8	2	8	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Renewable Technologies									
THEORY									
1.	BEEE0090	Introduction to Renewable Energy Technologies	3	0	0	0	3	3	
2.	BEEE0099	Design & Installation of Solar PV System	3	1	0	0	4	4	
3.	BEEE0095	Solar Energy System	3	0	0	0	3	3	
4.	BEEE0094	Wind Energy Conversion System	3	0	0	0	3	3	
PRACTICALS									
5.	BEEE0881	Solar Energy System Lab	0	0	2	0	1	2	BEEE0095
6.	BEEE 0882	Design & Installation of Solar PV System Lab	0	0	2	0	1	2	BEEE 0099
PROJECTS (IF EXIST)									
7.	BEEJ0972	Design & Installation of Solar PV System Project	0	0	0	8	2	8	BEEE0099

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Instrumentation & Control									
THEORY									
1.	BEEE0050	Sensors & Transducers	3	0	0	0	3	3	
2.	BEEE0056	PLC & SCADA	3	0	0	0	3	3	
3.	BEEE0052	Advance Control System	3	0	0	0	3	3	CS
4.	BEEE0053	Biomedical Instrumentation	3	0	0	0	3	3	
5.	BEEE0054	Process Control & Advanced Instrumentation	4	0	0	0	4	4	EMMI & CS
6.	BEEE0055	Digital Control System	3	1	0	0	4	4	
7.	BEEE0051	Optimal Control System	3	0	0	0	3	3	CS
PRACTICALS									
8.	BEEE0860	Process Control & Advanced Instrumentation Lab	0	0	2	0	1	2	BEEE0054
9.	BEEE0861	PLC & SCADA Lab	0	0	2	0	1	2	BEEE0056
PROJECTS (IF EXIST)									
10.	BEEJ0961	PLC Based Project	0	0	0	4	1	4	BEEE0056

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Energy Systems									
THEORY									
8.	BEEE0090	Introduction to Renewable Energy Technologies	3	0	0	0	3	3	
9.	BEEE0099	Design & Installation of Solar PV System	3	1	0	0	4	4	
10.	BEEE0100	Illumination Science & Engineering	3	1	0	0	4	4	
11.	BEEE0095	Solar Energy System	3	0	0	0	3	3	
12.	BEEE0094	Wind Energy Conversion System	3	0	0	0	3	3	
PRACTICALS									
13.	BEEE0881	Solar Energy System Lab	0	0	2	0	1	2	BEEE0095
14.	BEEE 0882	Design & Installation of Solar PV System Lab	0	0	2	0	1	2	BEEE 0099
PROJECTS (IF EXIST)									
15.	BEEJ0972	Design & Installation of Solar PV System Project	0	0	0	8	2	8	BEEE0099

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Electronics & Embedded System									
THEORY									
1.	BEEE0112	Digital Signal Processing	3	1	0	0	4	4	
2.	BEEE0110	Biomedical Signal Processing	3	0	0	0	3	3	
3.	BEEE0111	Analog & Digital Communication	3	0	0	0	3	3	
4.	BEEE0115	Medical Image Processing	4	0	0	0	4	4	
5.	BEEC0007	Analog Integrated Circuit	3	0	0	0	3	3	-
PRACTICALS									
6.	BEEE 0890	Medical Image Processing Lab	0	0	2	0	1	2	BEEE 0890

Projects (J)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BEEJ0950	Mini Projects - I	0	0	0	4	1	4	
2.	BEEJ0951	Mini Project - II	0	0	0	12	3	12	
3.	BEEJ0953	Minor Project	0	0	0	12	3	12	
4.	BEEJ0955	Major Project	0	0	0	32	8	0	
5.	BEEJ0991	Industrial Training	0	0	4	0	2	0	
		TOTAL	**0**	**0**	**0**	**60**	**17**		

Mandatory Non Graded Course (M)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
		THEORY							
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
		TOTAL	**8**	**0**	**0**	**0**	**0**	**8**	

Humanities and Social Sciences (H)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purpose – I	2	0	0	0	2	2	
4.	BELH 0004	English for Professional Purpose – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAC0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH 0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	4	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	4	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences (S)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR /WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences (G)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR /WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG1001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BEEG0002	Electrical Technology	3	0	0	0	3	3	
5.	BCSC0001	Computer Programming	4	1	0	0	5	5	
PRACTICALS									
6.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
	BEEG0801	Electrical Simulation Lab	0	0	4	0	2	4	
7.	BEEG0802	Electrical technology Lab	0	0	2	0	1	2	
8.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
9.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
10.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
11.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
TOTAL			16	4	14	0	28	16	

Open Elective (Offer to other Departments)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEO0090	Electrical Machine & Automatic Control	3	0	0	0	3	3	
2.	BEEO0092	Non-Conventional Energy Resources	4	0	0	0	4	4	
PRACTICALS									
3.	BEEO0900	Electrical Machines & Automatic Control Lab	0	0	2	0	1	2	BEEO0090

BEEG 1001: BASIC ELECTRICAL ENGINEERING

Credits: 04 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**DC circuit analysis & Network theorems:** Fundamentals of electric circuits, Kirchhoff's laws, mesh analysis, nodal analysis, Thevenin's theorem, maximum power transfer theorem, superposition theorem. **Steady state AC analysis:** AC fundamentals, average &rms values of different AC waveforms, phasor algebra, analysis of series AC circuits, power triangle, concept of power factor. **Three phase AC circuits:** Generation & advantages of three phase system, star & delta connection, line & phase voltage/current relations.	20
II	**Magnetic circuits:** Faraday's law, circuit analysis, analogy between magnetic and electric circuit, magnetic hysteresis. **Single phase Transformers:** Constructional feature, Working Principle, EMF equation, Ideal transformer, Equivalent Circuit, Phasor diagram, parameter evaluation using O.C & S.C test, efficiency, voltage regulation. **Rotating Electrical Machines:** **DC Machine:** Construction, operating principle, Need of Starter, EMF Equation, Types of DC Motor, Torque Equation, Torque-speed Characteristics and applications. **Induction motor:** 3-phase: Construction & Principle, Need of Starter, Torque Equation, Torque-slip Characteristics. **Single Phase Induction motor:** Principle and Starting methods.	22

Text Book:

- D.C. Kulshrestha, "Basic Electrical Engineering", Tata McGraw Hill.

Reference Books:

- T.K. Nagsarkar&M.S.Sukhija, "Basic Electrical Engineering", Oxford University Press.
- H. Cotton, "Advanced Electrical Technology", 2nd Edition, Wheeler Publishing.
- I. J. Nagarath, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill.
- D. E. Fitzgerald & A. Grabel Higginbotham, "Basic Electrical Engineering", 5th Edition, McGraw Hill.
- Edward Hughes, "Electrical Technology", 3rd Edition, Pearson Education.

Focus: This course focuses on Employability aligned with all COs.

Course Outcome: *After completion of course, students will be able to:*

1. Define the basic concept of active & passive elements, Linear & non-linear elements, Unilateral and Bilateral Elements, Ideal & Practical voltage and current sources.
2. Illustrate the working principle of various machines like DC Machine, and Induction motor.
3. Classify DC motors and induction motors.
4. apply the concept of KVL/KCL, Thevenin's theorem, Super position Theorem and Maximum power transfer theorem to solve the electrical circuits.
5. Compute the parameters of single phase and three phase AC electrical circuits, magnetic circuit and transformer.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PSO1, PSO3
CO4	PO1, PO2, PO3, PO4, PSO2, PSO3
CO5	PO1, PO2, PO3, PO4, PSO2

BEEG0800: ELECTRICAL ENGINEERING LAB

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I, & II	1. To Verify the Thevenin's Theorem (DC Circuits). 2. To Verify the Maximum Power Transfer Theorem (DC Circuits). Also Draw Graph between Power and Load Resistance. 3. To Verify the Superposition Theorem (DC Circuits). 4. To Study the Phenomenon of Resonance in R-L-C Series Circuit and to Draw Graph Between Frequency and Current. Also Show Half Power Points. 5. To Determine the V-I Characteristics of a Semiconductor Diode. Also Calculate Forward and Reverse Static and Dynamic Resistances. 6. To Study the Half Wave and Full Wave (Center Tapped) Rectifier With and Without Filter. Also to Calculate the Ripple Factor in Both Cases (Without Filter). 7. To Study Single Phase (Induction Type) Energy Meter. 8. To Study Various Logic Gates Such as OR, AND, NOT, NAND, NOR. 9. Study of CRO and Measurement of Voltage and Frequency Using CRO. 10. V-I Characteristics of Zener Diode. 11. Identification of Active and Passive Components. 12. V-I Characteristics of Bipolar Junction Transistor in Common Base Mode.	24

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: *At the end of the course students will be able*

1. Implement the basic electric circuits using rheostats, bread-board, resistors, capacitors, inductors, diodes, transistors, voltage sources, ICs, transformer, DSO/CRO and measuring devices.
2. Measure the various electrical quantities like voltage, current, frequency, power and energy.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1,PO2 ,PO3,PO4/PSO2, PSO3
CO2	PO1,PO2 ,PO3,PO4/PSO2

BEEC0006: BASIC SYSTEM ANALYSIS

Credits:4 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to signals and systems**: Classification of Signals, Transformations of Independent Variables (Time), Singularity Functions: Unit Step, Unit Ramp and Unit Impulse Function, Even and Odd Signals, Periodic and A periodic Signals, Real Exponential Signals, Complex Exponential Signals, Energy and Power Signals, Deterministic and Random Signals, Some more elementary functions – Rectangular Pulse Function, Triangular Pulse Function, Signum Function, Sinc function. **Basic systems**: Causal and Non Causal, Linear & Nonlinear, Time Varying and Time Invariant, System with & without Memory, Stable & unstable systems **Convolution Integral** **Fourier Transform Analysis**: Review of Fourier Transforms, Transform of Basic Signals and Periodic and Complex Waveforms, Properties of Fourier Transform, Initial and Final Value Theorems, Inverse Fourier Transform, Application of Fourier Transform to Analysis of Networks	21
II	**Laplace Transform Analysis**: Review of Laplace Transforms, Transform of Basic Signals and Periodic and Complex Waveforms, Properties of Laplace Transform, Initial and Final Value Theorems, Inverse Laplace Transform, Solution of differential equations using Laplace Transform, Waveform Synthesis, Application of Laplace Transform to Analysis of Networks. **Z-Transform Analysis**: Concept of Z-Transform, ROC, Finite Duration Sequences, Properties of Z-Transform, Inverse Z Transform, Initial and Final Value Theorems, Applications to Solution of Difference Equations. **Analogous System:** Linear Mechanical Elements, Force-Voltage and Force-Current Analogy, Modeling of Mechanical and Electro-Mechanical Systems	21

Text Books:

- D. Roy Choudhury, "Networks and Systems", 2nd Edition, New Age International, 2020
- Tarun Kumar Rawat, "Signals and Systems", 1st Edition, Oxford University Press India, 2010

Reference Books:

- Michael J. Roberts, "Signals and Systems", 3rdEdition, McGraw Hill Education, 2019
- H. P. Hsu and R. Ranjan, "Signals and Systems",Schaum's Outline, 2nd Edition, McGraw Hill Education, 2008
- A. Anand Kumar, "Signals and Systems", 3rd Edition, PHI Learning Private Limited, 2016
- Alan V. Oppenheim, Alan S. Willskyans S. H. Nawab, "Signals and Systems", Prentice Hall India, 1997
- B. P. Lathi, "Principles of Linear Systems and Signals", 2ndEdition, Oxford University Press India, 2009
- Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India Private Limited, 2021

Course Outcomes: Upon completion of this course, students shall be able to

CO1: Understand the difference among various types of signals and their practical applications.
CO2: Evaluate the response of a system for different types of signals.
CO3: Apply the concept of Laplace and Fourier transform for engineering problems.

CO4: Analyse the stability and instability of system with the help of Laplace and Z transform.
CO5: Model a physical system into its analogous electrical system.
CO6: Create the model of physical system based on input and output behavior.

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2
CO4	PO1, PO2, PO3, PO4, PSO2, PSO3
CO5	PO1, PO2, PO3, PO4, PSO1, PSO3
CO6	PO1, PO2, PO3, PO4, PSO2,

BEEC 0016: SIGNALS & SYSTEMS

Credits:3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hour
I	**Introduction to signals and systems**: Classification of Signals, Transformations of Independent Variables(Time), Singularity Functions: Unit Step, Unit Ramp and Unit Impulse Function, Even and Odd Signals, Periodic and Aperiodic Signals, Real Exponential Signals, Complex Exponential Signals, Energy and Power Signals, **Basic systems**: Causal and Non Causal, Linear & Nonlinear, Time Varying and Time Invariant, System with & without Memory, Convolution Integral **Fourier and Laplace Transform Analysis**: Review of Fourier & Laplace Transforms, Transform of Basic Signals and Periodic and Complex Waveforms, Initial and Final Value Theorems, Inverse Laplace Transform , Application of Fourier and Laplace Transform To Analysis of Networks,	21
II	**Z-Transform Analysis**: Concept of Z-Transform, ROC, Properties of Z-Transform, Inverse Z Transform, Initial and Final Value Theorems, Applications to Solution of Difference Equations. **Numerical computation of Discrete Fourier transform**: DFT & its Properties Obtaining output for discrete time systems for any arbitrary discrete input signal Discrete time systems, Discrete time convolution (graphical procedure), DFT method using FFT algorithms: Fast Fourier Transform, DIT FFT & DIF FFT algorithms, DFT & IDFT using FFT algorithms DFT using FFT & Inverse DFT, Discrete-time convolution using FFT	21

Text Books:

1. Lathi B P, Principles of Signal Processing & Linear Systems Oxford University Press,

References:

1. A V Oppenheim, A S Willsky, Nawab S N, “Signals & Systems”, PHI, Second Edition
2. Nagrath I J, Sharan S N, Ranjan Rakesh & Kumar S, Signals & Systems, Second Edition TMH.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *After completion of this course, the students will be able to*

1. Understand the various types of signals, systems, classification and their properties.
2. Compute the Fourier, Laplace Transform, Z-Transform, DTFT, inverse Laplace Transform and inverse Z-Transform of the given signals and/or systems.
3. Apply the FFT algorithms to compute the DFT of given signals.
4. Analyse the stability of system with the help of Laplace, Z transform, and Fourier transform.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2

BEEC0007: ANALOG INTEGRATED CIRCUIT

Objective: Ability to define, understands and explain the performance characteristics of Op-amp, applications of Op-amp, working of 555 timer, voltage regulators, A/D and D/A converters.

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hour
I	**Review of transistors**: Configurations of BJTs and FETs with their characteristics. **Feedback:** General Feedback Structure; Properties of Negative Feedback Amplifiers and types of feedback amplifier. **Oscillators**: -Conditions for oscillations Basic Principle of Sinusoidal Oscillator, R-C, LC Oscillators. **Current Mirror Circuits:** Current Mirrors using BJT and MOSFETs. Operational Amplifier, Characteristics and Applications: Basic Information of Op-Amp, Operational Amplifier Internal Circuit. DC and AC Characteristics, Instrumentation Amplifier, Applications of Op-Amp. **Active Filters:** First and Second order LP, HP active Filters	21
II	**Active Filters:** First and Second order BP, BS and All pass active Filters **Comparators and Waveform Generators: Comparator**, Regenerative Comparator (Schmitt Trigger), Square Wave Generator (Astable Multi vibrator), Mono stable Multi vibrator, Triangular Wave Generator. Voltage Regulator: Series Op-Amp Regulator, IC Voltage Regulators 555 Timer: Functional Diagram, Mono stable and Astable Operation, Schmitt Trigger. Phase-Locked Loop: Basic Principles, Phase Detector/Comparator, Voltage Controlled Oscillator (VCO), , Monolithic Phase-Locked Loop, PLL Applications A/D and D/A Converters- Weighted Resistors & R-2R D-A Converter, Flash Type, Single Ramp & Dual Ramp A-D Converters.	21

Text Books:

1. A.S. Sedra and K.C. Smith "*Microelectronics Circuits*"4th Edition, Oxford University Press (India).
2. Roy Choudhury, Shail B. Jain "*Linear Integrated Circuits*", 4th Edition, New Age International Publishers

References:

1. R.A. Gayakwad, "*OP-AMP and Linear Integrated Circuits*" Third edition, Prentice Hall of India.
2. Robert L. Boylestad and Louis nashel sky, "*Electronic devices and circuit theory*", Pearson Education/PHI,

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: *After completing the course the student will able -*

1. Explain the operation of BJT, FET, current mirror circuit, Op-amp, voltage Regulators, 555 timer, PLL.
2. Classify the feedback and oscillator circuit, active filters, A/D and D/A converters.
3. Apply the concept of Op-amp for active filters, different waveform generators, and PLL.

4. Evaluate the analog and digital output from A/D and D/A circuit respectively, and cut cut-off frequency of different types of active filters.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, , PSO1, PSO2, PSO3
CO6	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3

BEEC0805: ANALOG & DIGITAL ELECTRONICS LAB

Credits: 01 **L-T-P-J: 0-0-2-0**

Objective: *The laboratory serves the students to impart their essential knowledge of analog and digital electronics, to the circuit design and analysis. This laboratory enhances hands on experience of the students to design different electronic circuits with bread-boards and with different active & passive components.*

Module No.	List of Experiments:	Lab Hours
I,II & III	1. To Study V-I Characteristic of JFET and MOSFET. 2. Realization of Multistage Amplifier Using BJT and Calculation of Current Gain. 3. Realization of comparator and zero crossing detector using op- Amp. 4. Realization of adder and subtractor using op-Amp. 5. Realization of 2nd order active low pass and high pass filter. 6. Realization of triangular and sine wave generator using op-Amp. 7. Realization of Astable and Mono stable multi vibrator using IC 555. 8. Realization of full-adder & full subtractor using logic gates and using Boolean expression. 9. Realization of 4-bit even / odd parity checkers using Ex-OR gate. 10. Realization of 4-bit binary decoder/ demultiplexer. 11. Realization of 2-bit/ 4-bit multiplexer. 12. Realization of decimal to BCD encoder using IC 74147. 13. Realization and implementation of RS, JK, T and D flip-flop using logic gates. 14. Realization and implementation serial in parallel out and parallel in serial out shift register. 15. Realization and implementation 4-bit binary ripple counter using JK flip-flop. 16. Realization and implementation of 2-bit up/down synchronous counter.	24

- **Have to perform any 10 experiments out of these.**

Focus: This course focuses on Employability aligned with all COs.

Outcomes: A student who successfully fulfills the course requirements will have demonstrated an ability to:

CO1: design the electronic circuits with basic resistors, capacitors, ICs, and semiconductor devices with the given set of specifications.
CO2: test, and troubleshoot the analog & digital circuits.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1,PO2 ,PO3,PO4/PSO1, PSO2
CO2	PO1,PO2 ,PO3,PO4/PSO1, PSO2

BEEC 0806: ELECTRICAL MACHINES LAB-I

Credits: 1 **L-T-P-J:0-0-2-0**

Objective: To expose the students to the practical concepts of transformer as well as DC machines in order to analyze its performance.

Module No.	Content	Teaching Hours
I	1. To obtain magnetization characteristics of a D.C. shunt generator. 2. To obtain load characteristics of a compound generator (a) cumulatively compounded (b) differentially compounded. To obtain load characteristics of a D.C. shunt generator 3. To obtain efficiency of a dc shunt machine using Swinburn's test. 4. To perform Hopkinson's test and determine losses and efficiency of DC machine. 5. To obtain speed-torque characteristics of a dc shunt motor. 6. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control 7. To study Ward Leonard method of speed control of dc motor. 8. To perform polarity and ratio test of single phase transformer. 9. To perform open circuit and short circuit test in single phase transformer and find efficiency and voltage regulation. 10. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test. 11. To perform polarity and ratio test on 3-phase transformer. To study various connections of 3-pahse transformers. 12. To study Scott connection of transformers.	24

Focus: This course focuses on Employability aligned with all COs.

Outcome: *After successful completion of the lab student will able to*

CO1: Perform the experiment to analyze the characteristics of DC machines and Transformers.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1,PO4/PSO1, PSO2

BEEC0005: FIELD THEORY & APPLICATIONS

Credits: 3 **L-T-P-J: 3-0-0-0**

Module	Contents	Teaching Hours
I	Coordinate Systems and Transformation: Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar . Electrostatic fields: Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses' Law - Maxwell's equation, Electric dipole and flux line, Energy density in electrostatic fields, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric –constants. Electrostatic fields: Continuity equation and relaxation time, boundary conditions, Electrostatic boundary value problems: Poisson's and Laplace's equations., Methods of Images.	21
II	Magneto statics : Magneto -static fields, Biot - Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density - Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential. Magnetic forces: Materials and devices, Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole. Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy. Waves and Applications: Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form Electromagnetic wave propagation: Wave propagation in loss dielectrics, Plane waves in lossless dielectrics Plane wave in free space. Plain waves in good conductors, Power and the pointing vector, Reflection of a plain wave in a normal incidence. Transmission Lines and Smith Chart.	21

Text Book:

1. M. N. O. Sadiku , "Elements of Electromagnetic", 4th Edition , Oxford University Press

Reference Books:

1. W. H. Hayt and J. A. Buck, "Electromagnetic field theory", 7th Edision., TMH. Pramanik - Electromagnetism: Vol.1 - Theory, PHI Learning Pvt. Ltd

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: *After completion of course student will be able to-*

1. *Define various co-ordinate systems, fundamental laws and physical quantities in electromagnetic fields.*
2. *Evaluate the physical quantities of electromagnetic fields (Field intensity, Flux density etc.) in different medium, force exerted on charged particles and current elements.*
3. *Apply different techniques of vector calculus to understand concepts of electromagnetic field theory.*
4. *Analyze EM wave propagation, plane waves in loss and lossless dielectrics, reflection of in normal incidence, power & pointing vector of EM wave.*

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2/PSO1
CO3	PO1, PO2/ PSO1, PSO2
CO4	PO1, PO2, PO3/ PSO1, PSO3

BEEC0009: ELECTRICAL MACHINES-I

Objective: *To expose the students to the key concepts of transformer as well as DC machines and analyze it's performance.*

Credits:3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Single Phase Transformers**: Review: Classification; principle of operation, e.m.f. equation, equivalent circuit, losses and efficiency: maximum and all-day; voltage regulation. Testing : open circuit and short circuit tests, load test, Sumpner's test. **Autotransformers**: Principle of operation, equivalent circuit, comparison with two winding transformers **Three phase Transformers**: Construction of three phase transformers and their phase groupings; Phase transformation: three-phase to two-phase. Parallel operation of single and three phase transformers. Harmonics in transformers.	22
II	**D. C. Generators**: Construction, lap and wave type windings, function of commutator, emf equation, types of d.c. machines, characteristics. **D.C. Motors**: Armature reaction and its effects. Commutation: method of improving commutation, interpoles. Torque developed, losses and efficiency, Characteristics of different types of d.c. motors, d.c. motor starters. Testing of dc machines.	20

Text Books:

1. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill Education, 2004.
2. J. B. Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons, 2013.
3. Ashfaq Hussain, "*Electric Machines*", Dhanpat Rai and Sons, 2016.

Reference Books:

1. M.G. Say, "*The Performance and Design of AC machines*", Pit man & Sons ,2002.
2. A. E. Fitzgerald, C. Kingsley and Umans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill, 2015.
3. Alexander S. Langsdorf, "Theory of Alternating Current Machinery", McGraw Hill Book Company, 2009.
4. F. Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating Current Machines*", Asia Publishing House, 1962.
5. Alexander S. Langsdorf, " Principles of Direct-current Machines", McGraw Hill Book Company,1940.
6. Albert E.Clayton,"The Performance and Design of Direct Current Machines", The English Language Book Society,2000.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: After completion of the course, the students will be able to:

- CO1: Understand the construction and principle of operation of single, three phase transformers and auto transformers.
- CO2: Demonstrate construction and operation of DC generators and DC motors.
- CO3: Evaluate the performance in terms of efficiency, voltage regulation of transformers, and the methods of testing of transformers like open and short circuit tests and the Sumpner's test.

- CO4: Analyze the performance of DC machines by various testing methods including Ward leonard, Swinburn's and Hopkinson.

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO2, PSO3
CO5	PO1, PO2, PO3, PO4, PSO1
CO6	PO1, PO2, PO3, PO4, PSO1, PSO2

BEEC0010: ELECTRICAL MACHINES-II

Objective: To expose the students to the key concepts of synchronous as well as induction machines and analyze it's performance.

Credits:3 **L-T-P-J:3-0-0-0**

Module	Content	Teaching Hour
I	**Synchronous Machine-I:** constructional features, emf equation, winding coefficients, rotating magnetic field, armature reaction and Two Reaction Theory, phasor diagram based on Two Reaction Theory, expression for power developed in terms of load angle, open and short circuit tests, voltage regulation by Synchronous Impedance Method, MMF Method, ASA Method, Operation on infinite bus bar, parallel operation of synchronous generators, active and reactive power control of alternators operating on infinite bus bar. **Synchronous Machine-II:** starting of synchronous motors, effect of variation of field current at constant load and V-Curves, synchronous condenser, synchronizing power and torque, hunting.	21
II	**Three phase Induction Machine-I:** constructional features, principle of operation, phasor diagram, equivalent circuit, power flow and efficiency, relation between rotor power input, mechanical power developed and rotor copper loss, expression for torque and torque-slip characteristics. **Three Phase Induction Machine-II:** determination of parameters of equivalent circuit by no load and blocked rotor tests, methods of starting of three phase induction motors. Deep bar and double cage rotors, harmonics and its effects: cogging and crawling, induction generator and its applications. **Single Phase Induction Motor:** Double Revolving Field Theory, equivalent circuit, no load and blocked rotor tests. Different types of single phase induction motors: starting methods, characteristics and applications.	21

Text Books:

1. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill Education, 2004.
2. J.B.Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons, 2013.
3. Ashfaq Hussain, "*Electric Machines*", Dhanpatrai and Sons, 2016.

Reference Books:

1. M.G. Say, *"The Performance and Design of AC machines",* Pit man & Sons, 2002.
2. A.E. Fitzgerald, C. Kingsley and Umans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill Education, 2015.
3. Alexander S. Langsdorf, "Theory of Alternating Current Machinery", McGraw Hill Book Company,2009.
4. F. Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating Current Machines*", Asia Publishing House, 1962.

Focus: This course focuses on Employability aligned with all COs.

Course Outcome*: After completion of course student will be able to*

CO1: Explain constructional details of different type of Synchronous and Induction Machines, working principle and speed control concept of Induction Motors.
CO2: Demonstrate the parallel operation of alternators with supply mains.
CO3: Calculate the performance parameters of single phase and three phase induction motors.
CO4: Analyze the performance of synchronous machines by V Curves.
CO5: Evaluate the effects of harmonics on three phase induction motors.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO):

Cos	Pos/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO2
CO3	PO2, PO4, PSO3
CO4	PO1, PO2, PO3, PSO3
CO5	PO2, PO3, PO4, PSO3

BEEC0807: ELECTRICAL MACHINES LAB-II

Objective: To expose the students to the practical concepts of synchronous as well as induction machines in order to analyze its performance.

Credits: 1 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I	**Hardware based experiments** 1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit. 2. To perform load test on a three phase induction motor and draw: Torque -speed characteristics 3. To study speed control and reversal of direction of rotation of three phase induction motor by varying supply voltage. 4. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) Z P F method 5. To determine V-curves and inverted V-curves of a three phase synchronous motor at no load 6. To determine Xd and Xq of a three phase salient pole synchronous machine using the slip test and draw the power-angle curve. 7. To study synchronization of an alternator with the infinite bus by using two bright and one dark lamp method. **Software based experiments** 8. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance in the rotor circuit. 9. To determine speed-torque characteristics of single phase induction motor and study the effect of voltage variation. 10. To determine speed-torque characteristics of a three phase induction by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.	24

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *After performing experiments in this lab, students will able to*

- CO1: Perform and analyze the various characteristics of various AC machines.
- CO2: Simulate the speed torque characteristics of induction machines in Mat lab.

Mapping of Course Outcomes (CO) with Program Outcomes (PO) and Program Specific Outcomes (PSO):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1,PSO2
CO2	PO1, PO2, PO5, / PSO1, PSO2, PSO3

BEEC 0008: DIGITAL ELECTRONICS & CIRCUITS

Objective: To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Number Systems &Codes**: Decimal, binary, octal, hexadecimal number system and conversion, Floating point representation, 1's &2's complement, Signed binary numbers, signed binary numbers, weighted binary codes, Excess 3 code, Error Detecting and Correcting Codes. **Boolean Algebra & Minimization**: Boolean logic operation, Boolean laws, Digital Logic Gates, Demorgan's Theorems, Gate-level minimization: K-Map, POS simplification. **Combinational Logic**: Combinational circuits, analysis procedure, design procedure, Binary Adder-Sub tractor, Multiplexers, De-multiplexer, Decoders, Encoders.	20
II	**Synchronous sequential logic:** Sequential Circuits, Storage Elements: Latches, Flip Flops (S-R, J-K, D, T, MASTER SLAVE), Analysis of Clocked Sequential Circuits. **Registers and Counters:** Shift Registers, Ring Counter, Ripple Counter, Synchronous Counter, Other Counters. **Digital integrated circuits:** Logic levels, propagation delay time, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics TTL, CMOS and ECL integrated circuits and their performance comparison, open collector and tri-state gates and buffers. **Memory and programmable logic:** RAM , ROM, PROM, and EPROM.	20

Text Book:

1. M. Morris Mano and M. D. Ciletti, "*Digital Design*" 6th Edition, Pearson Education.
2. S. Salivahanan& S. Asivazhagan, "*Digital Circuit & Design*", IInd Edition

Reference Books:

1. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
2. John. M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2002.
3. Charles H.Roth. Fundamentals of Logic Design, Thomson Learning, 2003.
4. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, 6thEdition, TMH, 2003.
5. William H. Gothmann, Digital Electronics, 2nd Edition, PHI, 1982.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

1. Understand the basics of number system and different logic families.
2. Implement general problems on combinational circuits using optimized logic gates.
3. Construct sequential circuits which includes latches, fli- flop, shift register,ripple counter, synchronous counter, ring counter and also analysis of clocked sequential circuits.
4. Analyse the performance of memory devices like RAM, ROM, PROM, EPROM.

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

Cos	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 / PSO1, PSO2
CO3	PO1, PO2 /PSO1, PSO3
CO4	PO1, PO2, PO3 / PSO1, PSO3

BEEC0014: POWER ELECTRONICS

Objective: The course aims to enable students to understand application of power semiconductor switches in modern power application, and to analyze performance of different power electronics converters for various industrial and household applications.

Credits: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Thyristor:** Construction, V-I and Switching characteristics (Turn-On and Turn-Off), Two Transistor Model, Methods of Turn-On, Operation of GTO, DIAC, TRIAC, Firing Circuits for SCR, Protection of Devices, Series and Parallel Operation of Thyristors. **Commutation:** Commutation Techniques of Thyristor. **Phase Controlled Converters:** Single Phase Half Wave Controlled Rectifier With Resistive and Induction Loads, Effects of Freewheeling Diode, Single Phase Fully Controlled and Half Controlled Bridge Converters, Performance Parameters, Three Phase Half Wave Converters, Three Phase Fully Controlled and Half Controlled Bridge Converters, Effect of Source Impedance, Single Phase and Three Phase Dual Converters.	20
II	**Inverters:** Introduction (VSI), VSI-Single Phase Half and Full Bridge Inverters for R, RL and RLC Loads, Three Phase Bridge Inverters 180° and 120° Mode Operations. CSI-Single Phase Series Resonant and Parallel Inverters, Voltage Control of Inverters, Harmonic Reduction Techniques. **DC-DC Converters:** Principle of Step-Down Chopper, Step Down Chopper, control strategies for varying duty cycle, quadrant base classification of Choppers. **Cyclo converters:** Basic Principle of Operation, Single Phase to Single Phase, Three Phase to Single Phase and Three Phase to Three Phase Cyclo converters, Output Voltage Equation. **AC Voltage Controllers:** Introduction, Single Phase Ac Voltage Controller With Resistive and Inductive Loads, Three Phase Ac Voltage Controllers (Various Configurations And Comparison Only).	22

Text Books:

1. M. H. Rashid, Power, "Electronics: Circuits, Devices & Applications", Prentice Hall of India Ltd, 4th edition, 2013.

References:

1. M.D. Singh & K. B. Khanchandani "*Power Electronics*", TMH, 2nd edition (paperback), 2017.
2. Ned Mohan, T. M. Undeland and W. P. Robbins, "*Power Electronics: Converters, Applications and Design*", Wiley India Ltd, 3rd edition (paperback), 2009.
3. S. N. Singh, "*Modern Power Electronics and AC Drives*", Prentice Hall, 2001 (paperback edition).
4. V.R. Moorthy, "*Power Electronics: Devices, Circuits, Industrial Applications*", Oxford Univ. Press, 2005 (paperback edition).
5. P.S. Bhimbra, "*Power Electronics*", Khanna Publishers, 2018.

Course Outcomes: *After learning the course the students should be able to:*

CO1: Understand the switching characteristics and working of power semiconductor devices such as SCR, GTO, DIAC, TRIAC.

CO2: Compare the power converter performance for practical loads (R and RL).

CO3: Apply the different modulation techniques to PWM inverters for harmonic reduction.

CO4: Design power converter (controlled rectifier, inverter, DC-DC Converters, cyclo converters and ac voltage controller) circuits by assessing the requirements of application fields.

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1,
CO3	PO1, PO2, PO3, PO4, PSO2,PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2, , PSO3
CO5	PO1, PO2, PO3, PO4, PSO1, PSO3
CO6	PO1, PO2, PO3, PO4, , PSO3

BEEG0003: ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

Objective: To understand the internal structure of all instruments that are used in measuring parameters and also difference between analogue meters and digital meters and their performance characteristics.

Credits: 3 **L-T-P-J:3-0-0-0**

Module	Content	Teaching Hour
I	Philosophy of Measurement: Methods of Measurement, Classification & Characteristics of Instrument & Measurement System, Errors in Measurement & Its Analysis, Standards. Measurement of Current and voltage: Classification of Analog instruments. Principle of operation, construction, sources of error and compensations in PMMC, Dynamometer type instruments. Extension of ranges and calibration of ammeters & voltmeters. Measurement of power Power measurement – Voltmeter ammeter method, Electrodynamics wattmeter – Theory, errors and compensation. Instrument Transformers: Instrument Transformers and Applications in the Extension of Instrument Range. Measurement of Circuit Parameters: Different Methods of Measuring Low, Medium and High Resistances, Measurement of Inductance,	21
II	Measurement of Capacitance & Frequency with The Help of AC Bridges. Potentiometer. Sensors and Transducers: Classification of Sensors &Transducers, Resistive Transducers, Inductive Transducers. Digital Measurement: Concept of Digital Measurement, Block Diagram Study of Digital Voltmeter, Frequency Meter Power Analyzer and Harmonics Analyzer; Digital Multi meter Cathode Ray Oscilloscope: Basic CRO Circuit (Block Diagram), Cathode Ray Tube (CRT) & Its Components, Application of CRO in Measurement, Lissajous Pattern; Digital storage oscilloscope (Block Diagram, theory and applications only)	21

Text Books:

1. G.K. Banerjee, Electrical Measurement & Measuring Instruments, New Age International.
A.K. Sawhney, “A Course in Electrical & Electronic Measurements & Instrumentation”, Dhanpat Rai &Sons India.

References:

1. Forest K. Harris, “Electrical Measurement”, Willey Eastern Pvt. Ltd. India.
2. M.B. Stout, “Basic Electrical Measurement” Prentice hall of India, India.
3. Helfrick and Cooper, “Modern Electronic Instrumentation & Measurement Techniques”, PHI
4. Learning.
5. Rajendra Prashad, “Electrical Measurement & Measuring Instrument”, Khanna Publisher.
6. J.B. Gupta, “Electrical Measurements and Measuring Instruments”, S.K. Kataria& Sons.
7. MMS Anand, “Electronic Instruments and Instrumentation Technology”, PHI Learning.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

1. Understand measuring parameters, methods, standards, characteristics and errors in electrical and electronic measuring instruments.
2. Explain the application of CT, PT, resistive, inductive and capacitive transducers oscilloscopes and recorders.
3. Evaluate active power, power factor using wattmeter methods & resistance, inductance and capacitance using ac, dc bridges.
4. Analyse the performance characteristics of measuring instruments such as extension of range, Lissajous pattern etc.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes(PSO)

Cos	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 / PSO1
CO3	PO1, PO2 / PSO1, PSO2
CO4	PO1, PO2, PO3 / PSO1, PSO2, PSO3

BEEC0810: POWER ELECTRONICS LAB

Credits: 1 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I,II & III	**LIST OF EXPERIMENTS** 1. To study V-I characteristics of SCR and measure latching and holding Currents. 2. To study UJT trigger circuit for half wave and full wave control. 3. To study single-phase half wave controlled rectified with (i)resistive load (ii) inductive load with and without free-wheeling diode. 4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and Inductive loads. 5. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads. 6. To study single-phase ac voltage regulator with resistive and inductive loads. 7. To study single phase cyclo-converter. 8. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor 9. To study operation of IGBT/MOSFET chopper circuit. 10. To study MOSFET/IGBT based single-phase bridge inverter. 11. To obtain illumines control using TRIAC. **SOFTWARE BASED EXPERIMENTS (PSPICE/MATLAB)** 12. To obtain simulation of SCR and GTO thyristor. 13. To obtain simulation of Power Transistor and IGBT. 14. To obtain simulation of single phase fully controlled bridge rectifier and draw load voltage load current waveform for inductive load. 15. To obtain simulation of single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load. 16. To obtain simulation of step down dc chopper with L-C output filterfor inductive load and determine steady-state values of output voltage ripples in output voltage and load current. To perform 8-10 experiment from the above list	24

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *At the end of the course students will be able to,*

CO1: control the output of SCR based rectifiers and loads .

CO2: develop and troubleshoot MATLAB circuits for rectifiers, inverters and choppers.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1,PO2 ,PO3,PO4/PSO1,
CO2	PO1,PO2 ,PO3,PO4/PSO1, PSO1, PSO2
CO3	PO1,PO2 ,PO3,PO4/PSO3

BEEC 0018: Power System Transmission & Distribution

Objective: *The objective of the subject is to identify major components of power transmission and distribution systems. Describe the principle of operation of transmission and distribution equipment & to know and appreciate the key factors in equipment specification and design.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Overhead Transmission Line:** Types of conductors; Stranded conductors, ACSR Conductor, bundle conductors. Parameters of transmission line; Resistance, Inductance, Capacitance & conductance. Method for calculations of Inductance & Capacitance of 1-phase & 3-phase single circuit & double circuit Line, concept of GMR and GMD. Skin and proximity effect. **Performance of Transmission Line:** Characteristics & Performance of Transmission Lines; Short, Medium & Long Lines, Generalized Constants. Voltage Regulation and efficiency. Ferranti Effect. **Mechanical Design of Overhead Transmission Line:** Tension & Sag Calculation, Effect of weather conditions. Vibration & dampers. **Insulators:** Insulator materials & types – pin, disc & strain. Voltage distribution across a string &string efficiency. Methods to improve string efficiency; Capacitance grading & Guard ring.	21
II	**Corona:** Corona - Visual & Disruptive, Critical Disruptive Voltage. Corona Loss. Factors affecting Corona, Methods of reducing Corona, Electrostatic & Electromagnetic interference with Communication lines. **Insulated Cables:** Constructional features, Parameters, Cable laying procedures. High Voltage Cables & Thermal characteristics, Fault Location. **Distribution System:** Primary & Secondary Distribution, Ring Main & Radial System, Design of distribution system. **Representation of Power System:** Single Line Diagram, Per Unit system of calculation. Formation of Y-Bus & Z-Bus. **Load Flow Study:** Load Flow Problem, Power Flow Equations, Load Flow solution using Gauss Seidel& Newton Raphsonmethods, decoupled &fast decoupled method, Reactive Power Compensation.	21

Text Books:

1. D.P. Kothari and I.J. Nagarath, “Power System Engineering”, TMH.
2. W. D. Stevenson, “Element of Power System Analysis”, McGraw Hill.
3. M. V. Deshpande, “Electrical Power System Design” Tata Mc Graw Hill.

Reference Books:

1. B.R. Gupta, “Power System Analysis & Design”, S. Chand & Co.
2. Chakraborthy, Soni,Gupta&Bhatnagar, “Power System Engineering”, DhanpatRai& Co.
3. HaadiSaadat, “Power System Analysis”, McGraw Hill Publication.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1. Understand the skin effect, proximity effect, overhead line conductors and underground cables in power transmission.

CO2. Compute the electrical parameters of overhead transmission lines using the concept of GMD and GMR and load flow problem and various methods.
CO3. Analyze the performance of overhead transmission line, voltage regulation, efficiency and power transfer capability.
CO4. Design overhead transmission lines considering mechanical parameters, insulator, Corona aspects and distribution systems.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

Cos	POs/ PSOs
CO1	PO1, PO2 /PSO3
CO2	PO1, PO2 / PSO3
CO3	PO1, PO2 / PSO3
CO4	PO1, PO2, PO3 / PSO3

BEEC0012: ELEMENTS OF POWER SYSTEM

Credits: 03 **L-T-P-J: 3-0-0-0**

Course Objective: The objectives of this course are to make the students

1. *understand basic structure of power system*
2. *Understand and calculate transmission line parameters*
3. *Evaluate the electrical and mechanical performance of transmission lines*
4. *Understand insulators, corona effect, cables, distribution systems power system earthing and HVDC and EHVAC transmission systems.*

Module No.	Content	No. of Lectures
I	**Introduction:** Structure of Power Systems, Overview & growth of Power Systems; Indian-Scenario, Interconnections and their advantages **Transmission Lines:** Choice of voltage and frequency, Types of conductors, Bundled conductors. Calculation of Electrical parameters of Overhead Transmission Lines; Resistance, Inductance and Capacitance using the concept of GMR and GMD for 1-Phase, 3- Phase, Single Circuit & Double Circuit Lines, Skin effect, Proximity effect. **Transmission Line Performance-I:** Characteristics and Performance of Transmission Lines; Short and Medium - Generalized Constants, Power flow, and Voltage regulation. **Transmission Line Performance-II:** Characteristics and Performance of Long Transmission Lines, Ferranti Effect, Surge Impedance & Surge Impedance Loading. Indian Electricity Rules. **Mechanical Design of Overhead Transmission Lines:** Tension and Sag Calculations, Effect of weather conditions, Stringing Charts, Vibration & Damper.	22
II	**Insulators:** Insulator Types, String Efficiency & Methods to improve String efficiency; Capacitance grading, Guard ring. **Corona and Interference with Communication Lines:** Corona; Visual and Disruptive, Critical Voltage, Corona Loss, Factors affecting Corona. Methods of reducing Corona, Interference with Communication Lines. **Insulated Cables:** Constructional Features, Parameters. Electric stress in single-core cable, grading of cable. Cable laying procedures, Fault location methods. High Voltage Cables. Thermal Characteristics of cables. **Distribution Systems:** Primary and Secondary Distribution, Ring Main and Radial Systems, Systematic design of Distribution Systems. **Power System Earthing:** Soil Resistivity, Earth Resistance, Tolerable Step and Touch Voltage, Actual Touch and Step Voltages, Design of Earthing Grid. **HVDC Transmission and EHV-AC Transmission:** Introduction to HVDC and EHV-AC transmission systems and their comparison.	21

Text Books:

1. D.P. Kothari and I.J. Nagrath, "*Power System Engineering*",3rd edition Tata McGraw Hill, 2019.
2. B. R. Gupta, "*Power System Analysis and Design*", 7th Edition, S. Chand Publishing, 1998
3. John J. Grainger and W. D. Stevenson, Jr, "*Power System Analysis*", 1st Edition, Tata McGraw-Hill, 2004

References:

1. Ashfaq Husain, "Electrical *Power System",*5th Edition, CBS Publishers and Distributors, 2014
2. C. L. Wadhwa, "*Electrical Power Systems*", 7th Edition, New Age International Ltd., 2017
3. S. N. Singh, "Electric Power Generation, Transmission& distribution." 2nd Edition, PHI Learning, 2021

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: After completion of the course, students shall be able to:

CO1. Understand the structure of an interconnected power system including generation, transmission and distribution; their function and growth, skin effect and proximity effect.
CO2. Understand the mechanical design of overhead transmission lines considering insulation and Corona aspects and also the constructional features of single and multi-core cables, grading and thermal rating of cables, electric distribution system, power system earthing, HVDC and EHVAC Transmission.
CO3. Calculate the electrical parameters of overhead 1-phase and 3-phase transmission lines using the concept of geometrical mean distances and geometrical mean radius.
CO4. Analyze short, medium and long transmission line models to obtain their performance – voltage regulation, efficiency and power transfer capability.
CO5. Evaluate sag and tension, string efficiency, electric stress in cables and fault location, minimum voltage point for different distribution systems, soil resistivity, step and touch voltage in substations.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO2,
CO4	PO1, PO2, PO3, PO4, PSO2, , PSO3
CO5	PO1, PO2, PO3, PO4, PSO1,

BEEC 0013: POWER SYSTEM ANALYSIS

Credits: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Representation of Power System:** Single Line Diagram, Impedance & Reactance Diagram, Per Unit System of calculation. **Load Flow Study:** Network model. Formation of Y_{BUS} by inspection and by graph theory. Formulation of load flow problem. Gauss-Seidel method of load flow-analysis. Representation of voltage-controlled buses in load-flow analysis. Newton-Raphson method of load-flow analysis. Decoupled and Fast Decoupled Methods, Comparison of Load Flow Methods. **Economic Operation of Power Systems:** Economic dispatch problem in thermal power stations. Consideration of transmission losses in economic dispatch. Development of loss-formula. **Fault Analysis**: Types of Fault. Synchronous machine model for fault analysis. Calculation of Fault Current and voltages for symmetrical short circuit.	21
II	**Fault Analysis**: Symmetrical components of unbalanced phasors, power invariance transformation. Sequence impedance and sequence network of power system elements. Unsymmetrical short-circuits. Open conductor fault. Z_{BUS} method for the analysis of unsymmetrical shunt faults. Current limiting reactors. **Transient Stability Studies**: Types of Stability, Swing Equation, coherent group of machines. Power Angle Curve. Equal Area Criterion & Its Applications; Step-by-Step Solution of Swing Equation. Factors affecting stability of system & methods of improving stability **Surge Phenomenon**: Classification of Over-voltages; Travelling Wave Equation for a Long Line, Surge Impedance. Reflection and refraction of surges, Bewly Lattice diagram. Protection from Surges.	20

Text Books:

- I.J. Nagrath and D.P. Kothari, "*Modern Power System Analysis*", Tata McGraw Hill, 4th edition.
- J. Grainger & W. D. Stevenson, "*Power System Analysis*", McGraw Hill.
- B. R. Gupta, "Power System Analysis and Design", S. Chand & Co.

References:

- C. L. Wadhwa, "Electrical Power Systems", New Age International Ltd.
- AshfaqHussain, "Power System", CBS Publishers and Distributors.
- Chakraborthy, Soni,Gupta&Bhatnagar, "Power System Engineering", DhanpatRai& Co.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completing the course, the students shall be able to:

1. Understand the methods of Y bus, Z bus formulation and G-S, N-R and fast decoupled methods of load flow analysis, over-voltage classification methods of improving stability in power system.
2. Calculate per unit system values, sequence components, fault currents, critical clearing angle, reflection and refraction coefficient for voltage and current wave in transmission line.
3. Evaluate the condition of economic scheduling of thermal power plants including transmission losses.
4. **A**nalyze symmetrical, unsymmetrical faults, economic scheduling and load dispatch, transient stability and traveling wave phenomenon's in power systems.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1,PO2 ,PO3,PO4/PSO1,
CO2	PO1,PO2 ,PO3,PO4/PSO1, PSO2
CO3	PO1,PO2 ,PO3,PO4/PSO2
CO4	PO1,PO2 ,PO3,PO4/PSO1, PSO3

BEEC0015: MICROPROCESSOR & IT's APPLICATIONS

Objective: *The Purpose of the course is to provide students with the Knowledge of Microprocessors, basic of Microcontroller and peripheral. To solve real world problems in an efficient manner, this course also emphasis on architecture, Programming and system design used in various day-to-day gadgets.*

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	Introduction to Microprocessor, Components of a Microprocessor: Registers, ALU and control & timing, System bus (data address and control bus), Microprocessor systems with bus organization. Microprocessor Architecture and Operations, Memory, I/O devices, Memory and I/O operations. 8085 Microprocessor Architecture, Address, Data And Control Buses, 8085 Pin Functions, Demultiplexing of Buses, Generation Of Control Signals, Instruction Cycle, Machine Cycles, T-States, Assembly Language Programming Basics, Classification of Instructions, Addressing Modes, 8085 Instruction Set, Instruction and Data Formats, Writing, Assembling & Executing a Program, Debugging the Programs. Writing 8085 assembly language programs with decision, making and looping using data transfer, arithmetic, logical and branch instructions.	21
II	Stack & Subroutines, Developing Counters and Time Delay Routines, Code Conversion, BCD Arithmetic and 16-Bit Data operations, Interrupts In 8085, Interfacing Concepts, Memory Interfacing ,Ports, Interfacing Of I/O Devices, , Programmable Peripheral Interface 8255A, TIMER IC 8253,Programmable Interrupt Controller 8259A, **Advanced Microprocessors**: 8086 logical block diagram and segments, Addressing Modes, **Introduction to Microcontrollers and Embedded Processors**	21

Text Book:

1. B Ram "Fundamental of Microprocessor & Microcontrollers", DhanpatRai publication.

Reference Books:

1. Ramesh S. Gaonkar , "Microprocessor Architecture, Programming, and Applications" with the 8085, Pub: Penram International.
2. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah "Microprocessors and Interfacing", Oxford
3. Daniel Tabak "Advanced Microprocessors", McGrawHill.
4. Douglas Hall "Microprocessor & Interfacing" , TMH.
5. Savaliya M. T. "8086 Programming and Advance Processor Architecture", WileyIndia.
6. Triebel& Singh "The 8088 and 8086 Microprocessors", Pearson Education.
7. Kenneth Ayala "The 8051 Micro controller" 3rd Edition.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *After learning, the course the students should be able to:*

1. *Understand the various features of microprocessor,* microcontrollers and embedded system *,memory and I/O devices including concepts of system bus and 8085 processor addressing modes, instruction classification, function of each instruction, and write the Assembly language programs using 8085 instructions.*
2. *Explain the architecture of 8085 and 8086 microprocessor, its bus organization including control signals.*
3. *Analyze the concepts of memory and I/O interfacing with 8085 processor with Programmable devices.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1, PO2/PSO1
CO3	PO1,PO2/PSO1, PSO2

BEEE 0054: PROCESS CONTROL & ADVANCE INSTRUMENTATION

Objective: *To prepare the students have successful career in industry and motivate for higher education. To provide strong foundation in basic science and mathematics necessary to formulate, solve and analyze Control and Instrumentation problems.*

Credits:
04 **L–T–P: 4–0–0**

Module	Content	Teaching Hours
I	**Introduction to Industrial Automation and control:** Architecture of Industrial automation systems. **Introduction to Sensors and Measurement systems**: Temperature measurement, pressure and force measurement, displacement and speed measurement, flow measurement techniques, measurement of level, humidity and ph. Signal conditioning and processing estimation of errors and calibration. **Introduction to Process Control**: Process characteristics, proportional(P),integral(I),derivative(D),PI,PD and PID Control modes, controller tuning. **Special Control Structures**: Feed-forward and ratio control, predictive control, control of systems with inverse response cascade control, overriding control, selective control, split range control, Electronic, pneumatic and digital controllers.	21
II	**Electrical Control elements**: Construction and principle of operation of solenoids, stepper motor, AC/DC motor, limit switches, relays, auto transformer and magnetic amplifiers. **Introduction to Actuators**: Flow control valves. Control valves: Principle of operation and constructional details of solenoid valves, diaphragm operated valve, piston operated valve, valve petitioners, control valve characteristics and their sizing, temperature switches flow switches, interlocking and sequencing circuits. Hydraulic **Actuator systems**: Principles, components and symbols, pumps and motors, proportional and servo valves. **Pneumatic Control systems**: System components, controllers, and integrated control systems. Introduction to Sequence control: PLCs and relay ladder Logic.	21

Text Book:

- George Stephanopoulos, "Chemical Process Control: An Introduction to Theory and Practice", Prentice-Hall, 1984.

References:

- Harrist P, "Process Control", McGraw Hill.
- Johnson, Curtis D, "Process Control Instrumentation Technology", John Wiley and Sons.
- B.C. Nakra&K.Chaudhry, "Instrumentation, Measurement and Analysis", Tata McGraw Hill 2nd Edition.
- A.K.Sawhney, "Advanced Measurements & Instrumentation", DhanpatRai& Sons.

Outcomes:

- *Ability to understand and apply basic science, circuit theory, control theory signal processing and*
- *Apply them to engineering problems.*
- *Ability to model and analyze transducers.*
- *Ability to understand and analyze Instrumentation systems and their applications to various industries.*
- *Ability to apply advanced control theory to practical engineering problems.*

Outcomes:

1. *Understand the basic components of instrumentation system.*
2. *Explain various measurements such as temperature, speed, flow, pressure etc. Design a data acquisition system.*
3. *Analyze the working of transducer, Instrumentation systems, and their applications to various industries.*
4. *Explain the construction and operating principle of feed forward and ratio control, electronic pneumatic and digital control.*

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2

BEEE 0030: ELECTRICAL POWER GENERATION

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Importance of Electrical Energy, Comparison with other forms of energy. Electrical energy sources. **Power Plant Economics and Tariffs:** Load Curve, Load Duration Curve, Different Factors related to plants and consumers, Cost of electrical energy. Depreciation, Tariffs, Causes and effects of low power factor. Different methods for power factor improvement and advantages of pf improvement. **Power Plant Auxiliaries:** Excitation system, Turbine and Governors, Storage Batteries. EHV Substation – classification & its equipment. **Thermal Power Plant:** Location and site selection, general layout and working of plant. Brief description of Boilers, Economizers, Super heaters, Draft system. Fuel and Ash handling plant. **Gas Turbine Power Plant:** Layout & operational principle of Gas Turbine Plant & its efficiency, Fuels, Open and Closed-cycle plants, Regeneration, Inter-cooling and reheating.	21
II	**Nuclear Power Plant:** Location, Site selection, General layout and operation of plant, Brief description of different types of Reactors, Moderator material, Fissile materials. Control of nuclear reactors, Disposal of nuclear waste, Shielding. **Hydro Electric Plants:** Classifications, Location and site selection, Detailed description of various components, General layout and operation of plants, Brief description of Impulse, Reaction, Kaplan and Francis turbines. Advantages & disadvantages. **Wind Energy:** Basic principles of Wind energy conversion, Wind energy power calculation, Analysis of aerodynamic forces acting on the Blades, Site selection considerations, Types of wind energy Collectors, applications of wind energy. **Solar Energy:** Solar radiation at the Earth's surface, Solar radiation measurement, Solar energy Collectors, Solar Thermal Power Plant, Solar PV Cells. Applications of Solar Energy. **Neutral Earthing:** Introduction, isolated neutral, earth neural systems-solid, resistance & reactance. Arc suppression coil, voltage transformer earthing transformer. Substation Automation: Requirement & Cost Justification.	21

Text Books:

1. B. H. Khan, "*Non-conventional Energy Resources*", 2nd Edition 2009, Tata Mcgraw-Hill Education.
2. B. R. Gupta, "*Generation of Electrical Energy*", 7th Edition 2017, S. Chand Publication 2017.

References:

1. Soni, Gupta & Bhatnagar, "*A Text Book on Power System Engg. 2nd Edition, 2000",* Dhanpat Rai & Co.

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: At the end of the course the students will be able to:

1. Understand the concept of various economic factors, load curve, load duration curves, excitation system, turbine & governor and stations storages batteries
2. Explain the operating principle and layout of thermal, hydro, nuclear, gas, wind and solar power plants.
3. Analyze the cost of energy generated, type of tariffs, most economic power factor selection, fill factors & power output of solar PV plant.
4. Classify the neutral earthing and explain requirement of substation automation and cost justifications.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2/PSO1
CO3	PO1/PSO1, PSO2, PSO3
CO4	PO1, PO2/PSO1, PO2

BEEE 0031: HIGH VOLTAGE ENGINEERING

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	Level of high voltage, electrical insulation and dielectrics, importance of electric field intensity in the dielectrics. **Break Down In Gases:** Properties of atmospheric air, SF6 and vacuum ionization processes, Townsend's criterion, breakdown in electronegative gases, time lags for breakdown, Streamer theory, Paschen's law, and breakdown in vacuum. **Break Down In Liquid Dielectrics:** Classification & Properties of liquid dielectric, characteristic of liquid dielectric, breakdown in pure liquid and commercial liquid. **Break Down In Solid Dielectrics**: Classification & Properties of solid dielectrics, intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric in Practice, breakdown in composite dielectrics.	20
II	**Generation of High Voltages and Currents:** Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of Impulse generator sources of overvoltage. **Measurement of High Voltages and Currents:** Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements. **Non-Destructive Testing:** Measurement of direct current resistively, measurement of dielectric constant and loss factor, partial discharge measurements. **High Voltage Testing:** Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, testing of transformers, testing of surge arresters.	21

Text Books:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", 5th Edition, 2017, Tata Mc-Graw Hill.

References:

1. E. Kuffel and W. S. Zacngal, "High Voltage Engineering", 2nd Edition, 2000, Pergamon Press.
2. C. L. Wadhwa, "High Voltage Engineering", 2nd Edition, 2007, Wiley Eastern Ltd.

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes*:* At the end of the course the students will be able to:

1. *Understand fundamental concepts of high voltage AC, DC, impulse generation and destructive and non destructive testing procedure of power equipments.*
2. *Apply the different measurement technique to compute high ac/dc voltage and current*
3. *Analyze the reasons behind electric breakdown in liquids, gases, and solids.*
4. *Design the various ac/ dc high voltages and current generation circuits.*

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1, PO2/PSO1
CO2	PO1, PO2, / PSO1, PSO2
CO3	PO1, PO2/PSO3
CO4	PO1, PO2, PO3/ PSO1, PSO2, PSO3

BEEE 0032: SMART GRID

Objective: *To enable the students to acquire knowledge on smart grid, different options of architectural design and sensors, measurement technology for various aspects of smart grid, renewable energy sources and power quality management, information and communication technology for smart grid.*

Credits: 03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	Introduction to Smart Grid: Evolution of electric grid, concept of smart-grid, definitions, need of smart grid, functions of smart grid, opportunities & barriers of smart grid, difference between conventional & smart grid, concept of resilient &self-healing grid, present development & international policies on smart grid. Smart Grid Technologies: Part 1 Introduction to smart meters, real time pricing, smart appliances, automatic meter reading(AMR), outage management system(OMS), plug in hybrid electric vehicles(PHEV), vehicle to grid, smart sensors, home & building automation, phase shifting transformers. Smart Grid Technologies: Part 2 Smart-substations, substation automation, feeder automation. geographic information system(GIS), intelligent electronic devices(IED) & their application for monitoring & protection, smart storage like Battery, SMES, pumped hydro, compressed air energy storage, wide area measurement system(WAMS), phase measurement unit(PMU).	22
II	Power Quality Management in Smart Grid Power Quality & EMC in Smart Grid, power quality issues of grid connected renewable energy sources, power quality conditioners for smart grid, web based power quality monitoring, power quality audit. Information and Communication Technology for Smart Grid Advanced metering infrastructure (AMI), home area network (HAN), neighborhood area network (NAN), wide area network (WAN). Bluetooth, zig-bee, GPS, Wi-Fi, Wi-Max based communication, wireless mesh network, basics of CLOUD Computing & cyber security for smart grid. Broad-band over power line (BPL). IP based protocols.	20

Text Books:

- Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley, 2010
- Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press, 2009
- S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
- Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press, 2008

Reference Books:

- Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", ArtechHouse Publishers July 2011
- R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System

Quality",2nd Edition, McGraw Hill Publication, 2002

- Yang Xiao, "Communication and Networking in Smart Grids", CRC Press, 2012

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the fundamental elements and structure of the smart grid.
CO2: Demonstrate the use of HAN, NAN, WAN for designing a smart grid.
CO3: Analyze communication, networking and sensing technologies involved with the smart grid.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3

BEEE 0034: POWER SYSTEM OPERATION & CONTROL

Objective: To expose the students to key concepts of operation and control of modern power system.

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Concept of energy control center (or) load dispatch centre and their functions, time-scale for various control problem. System hardware configuration – SCADA and EMS functions. State estimation. Various operating states of power system -Normal, alert, emergency, in-extremis and restorative states, state transition diagram. Contingency analysis and security assessment. **System load variation:** Load forecasting and simple techniques of forecasting. **Economic operation:** Unit commitment, Hydro-thermal scheduling – short term and long term. Derivation of transmission loss formula. **Automatic generation control (AGC):** Concept of automatic-generation/load-frequency and voltage control.	21
II	AGC of single area system – modeling of speed governing system and turbine modeling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, AGC and economic dispatch control. **AGC of two area system**: Modeling of two area system for AGC including tie line power flow. Block diagram and state-space representation of two-area system. Static and dynamic response. **Automatic voltage control:** Concept of voltage control - Schematic diagram and block diagram representation, modeling of Excitation system. Voltage and reactive power control: Methods of voltage control by tap changing transformer, shunt compensation, series compensation and phase angle compensation. **Flexible AC transmission systems:** Concept and objectives of FACT's controllers, structure and characteristics of FACT's controllers - TCR, FC-TCR, TSC, SVC, STATCOM, TSSC, TCSC, SSSC, TC-PAR, UPFC.	21

Text Books:

1. D.P. Kothari and I.J. Nagrath, "Modern Power System Analysis" Tata McGraw Hill, 4th edition.
2. P.S.R. Murty, "Operation and control in Power Systems" B.S. Publications.
3. A. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control "John Wiley & Sons.

References:

1. O.I. Elgerd, "Electric Energy System Theory" Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *Upon completion of this course, students will be able to*

CO1: Understand the modeling and control of single area and two area power system including the concept of AGC.
CO2: Calculate various factors including maximum demand, load factor, demand factor, diversity factor etc.
CO3: Apply the concept of AGC, AVC and FACT controllers in power system operation.
CO4: Analyze the performance of economic operation of interconnected thermal-thermal and hydro-thermal power systems.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO):

Cos	Pos/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO2
CO3	PO2, PO4, PO5, PSO3
CO4	PO2, PO3,PO4, PSO3

BEEE 0035: SWITCHGEAR AND PROTECTION

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Protection System:** Philosophy of protection, nature, causes and consequences of faults, requirements of a protective scheme, Basic terminology and components of protection scheme. Fuse, Isolators. **Relays:** Need for protective relaying,Protective Zones, Primary and back up protection, Properties of protective relaying, Relay classification, Principle and operation of electromagnetic and Induction type relay, Relay settings, Types of Relays; Directional, Distance, Differential, Over Current and earth fault relays, Buchholz relay, Harmonic resistant relay, **Static relays -** (amplitude and phase comparator), Numerical relay/IEDs (Intelligent Electronic Devices).	20
II	**Protection Schemes:** Protection of Feeders, Generator, Transformer and Transmission line. Bus Zone and Pilot protection. **Over Voltage Protection**: Spark gaps, Arresters, Surge absorbers. BIL, Insulation coordination, Grounding of Power System. **Circuit Breakers-I**: Theory of arc formation, properties of arc. Theories of arc Interruption, RRRV, Current chopping, Duties of switch-gear, Resistance switching. Construction and operation of Air CBs, Oil CBs, Single and Multi-break construction, Vacuum circuit breaker, SF_6 circuit breaker, D.C. circuit breaker. **Circuit Breakers-II**: Comparative merits and demerits of CBs, Application of CBs, Circuit breaker rating, Recent development in circuit breakers	20

Text Books:

1. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", 2nd Edition 2004, PHI.
2. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", 2nd Edition 2017, TMH.

References:

1. Bhavesh Bhalja, R.P.Maheshwari & Nilesh Chothani, " Protection & Switchgear", 2nd Edition 2018, Oxford university press
2. S. S. Rao, "Switchgear Protection and Power System", 14th Edition 2019, KhannaPublishers

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: *At the end of the course the students will be able to:*

1. *Understand the fundamental concept of protection philosophy, protective relays, BIL, insulation coordination and constructional features of SF6, Air, Oil and Vacuum circuit breakers.*
2. *Distinguish the characteristics of under voltage, over current, differential, distance relays and Lightning arrestors etc.*
3. *Evaluate the various PSM and TSM for desired speed, sensitivity and selectivity of protective relaying.*
4. *Analyze the various protective schemes, breaker ratings and RRRV, CC, resistance switching phenomenon of circuit breakers.*

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2,/ PSO1, PSO2
CO3	PO1, PO2/PSO1,
CO4	PO1, PO2/ PSO1, PSO2, PSO3

BEEE 0050: SENSORS AND TRANSDUCERS

Objective: *To make students familiar with the constructions and working principle of different types of sensors and transducers and their uses.*

Credits:03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Mechanical and Electromechanical sensor**: Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. **Inductive sensor**: common types- Reluctance change type, Mutual inductance change type, transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input output variable, Ferromagnetic plunger type, short analysis. LVDT: Construction, material, output input relationship, I/O curve, discussion. Proximity sensor. **Capacitive sensors**: Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics. **Piezoelectric element**: piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors	21
II	**Thermal sensors**: Material expansion type: solid, liquid, gas & vapor Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification. **Thermoemf sensor**: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison. Pyroelectric type. **Magnetic sensors**: Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics. Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response. Geiger counters, Scintillation detectors, Introduction to smart sensors.	21

Text Books:

- Sensor & transducers, D. Patranabis, 2nd edition, PHI, 2003
- Instrument transducers, H.K.P. Neubert, Oxford University press, 1999
- Measurement systems: application & design, E.A.Doebelin, McGraw Hill, 1990

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the basic principle of Sensors and Transducers and their classifications
CO2: Explainthe working principle of Electrical, Thermal and Magnetic Sensors
CO3: Analyze the characteristics of different types of Transducers and Sensors
CO4: Distinguish among different types of Transducers and Sensors

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO3
CO3	PO1, PO2, PO3, PO4,/ PSO1,PSO2
CO4	PO1, PO2, PO3, PO4,/ PSO2, , PSO3

BEEE 0051: OPTIMAL CONTROL SYSTEMS

Objective: *To aware the students about Stochastic Optimal Linear Estimation, Control Stochastic processes and Microprocessor and DSP control Basic computer Architecture.*

Credits: 03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	General Mathematical Procedures: Formulation of the optimal control Problem, Calculus of variations, Minimum principle, Dynamic Programming, Numerical Solution of Two-point Boundary value problem. Optimal Feedback Control: Discrete-Time linear State regulator, Continuous-Time Linear state Regulator results to solve other linear problems, Suboptimal Linear regulators, Minimum-time Control of Linear Time-Invariant System, Stochastic Optimal Linear Estimation and Control, Stochastic processes and linear systems, Optimal Estimation for Linear Discrete time Systems, Stochastic Optimal Linear Regulator.	20
II	Microprocessor and DSP control Basic computer Architecture, Microprocessor Control of Control System, Single Board Controllers with Custom Designed Chips, Digital Signal Processors, Effect of finite World Length and Quantization on Controllability and Closed Loop–Pole Placement, Effects of Quantization, and Time Delays in Microprocessor Based control systems.	20

Text Books:

1. M. Gopal, “Modern Control Engineering”, New Age International Publishers, 1996.
2. B.C. Kuo, “Automatic Control Systems”, 10th Ed. McGraw Hill, 2017.

Reference Books:

1. Brain D.O. Anderson, John B. Moore, “Optimal control Linear Quadratic Methods”, Prentice Hall of India Private Limited, 2000.
2. D. S. Naidu: Optimal Control Systems, CRC Press, 2002.
3. Sinha: Linear Systems: Optimal and Robust Control, CRC Press, 2007.
4. E. Bryson and Y-C Ho: Applied Optimal Control, Taylor and Francis, 1975.
5. P. Sage and C. C. White, III: Optimum Systems Control (2nd Ed.), Prentice Hall, 1977.
6. D. E. Kirk: Optimal Control Theory: An Introduction, Prentice Hall, 1970.
7. J. L. Crassidis and J. L. Junkins: Optimal Estimation of Dynamic Systems, CRC Press, 2004.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the Formulation of the optimal control Problem, Calculus of variations, Minimum principle, Pole Placement, Effects of Quantization, and Time Delays in Microprocessor Based control systems.

CO2: Analyze Microprocessor Control of Control System, Single Board Controllers with Custom Designed Chips, Digital Signal Processors.

CO3: Estimate optimality for Linear Discrete time Systems Stochastic, Optimal Linear Regulator

CO4: Design Discrete-Time linear State regulator, Continuous-Time Linear state Regulator results to solve other linear problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEE 0055: DIGITAL CONTROL SYSTEM

Objective: *The aim of the course is to present control theory that is relevant to the analysis and design of computer-controlled systems, with an emphasis on basic concepts and ideas.*

Credits: 04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	Basic control system, advantages of digital control and implementation problems, basic discrete time signals, Modeling of sample-hold circuit, pulse transfer function, solution of difference equation by z- Transform method. **Design of Digital Control Algorithms:** Steady state accuracy, transient response and frequency response specifications, digital compensator design using frequency response plots and root locus plots. **State Space Analysis and Design:** State space representation of digital control system, conversion of state variable models to transfer functions and vice versa, solution of state difference equations, controllability and observability, design of digital control system with state feedback.	22
II	**Stability of Discrete System:** Stability on the z-plane and Jury stability criterion, bilinear transformation, Routh stability criterion on rth plane. Lyapunov's Stability in the sense of Lyapunov, stability theorems for continuous and discrete systems, stability analysis using Lyapunov's method. **Optimal digital control :** Discrete Euler Lagrange equation, max. min. principle, different types of problems and their solutions.	21

Text Books:

- B.C.Kuo, "Digital Control System", Saunders College Publishing, 1991
- M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill, 2006

Reference Books:

- R.Leigh, "Applied Digital Control", Prentice Hall, International, 1985
- C.H. Houpis and G.B. Lamont, "Digital Control Systems :Theory, hardware, Software", McGraw Hill publications, 1992

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the basic sampling theorem to convert a continuous-time system into a discrete-time system (frequency and time domain techniques) and state space model

CO2: Demonstrate the optimal digital control algorithm

CO3: Determine the poles of a second-order system based on the system's transient response of discrete-time systems

CO4: Analyze the stability of a closed-loop of discrete time systems using R-H criterion and Lyapunov's method

CO5: Design the digital controller and compensator using root locus

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO1, PSO2, PSO3

BEEE 0056: PLC & SCADA

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**PLC Introduction:** Technical Definition, advantages, characteristics, Chronological Evolution, Types of PLC: Unitary, Modular, Small, Medium and Large. Block Diagram of PLC: Input/output (I/O) section, Processor Section, Power supply, Memory central Processing Unit: Processor Software / Executive Software, Multi-tasking, Languages, Ladder Language. **Bit Logic Instructions:** I/O Symbols, Numbering system of inputs and outputs, Program format, introduction to logic: Equivalent Ladder diagram of various logic gates, De Morgan theorem validation. **Timers and Counters:** Timer-on Delay, Timer off delay, Retentive and non-retentive timers. Format of a timer instruction. Operation of PLC Counter, Counter Parameters, Counters Instructions Overview Count up (CTU) Count down (CTD). **Advanced instructions:** Introduction: Comparison instructions, discussions on comparison instructions, "EQUAL" or "EQU" instruction, "NOT EQUAL" or "NEQ" instruction, "LESS THAN" or "LESS" instruction, "LESS THANOR EQUAL' or "LEQ" instruction, GREATER THAN" OR "GRT" instruction, "GREATER THAN OR EQUAL TO" or "GRO" instruction, "MASKED COMPARISON FOR EQUAL" or "MEQ" instruction, "LIMIT TEST" or "LIM" instruction.	23
II	**PLC input output (I/O) modules and power supply:** Classification of I/O, I/O system overview, practical I/O system and its mapping addressing local and expansion I/O, input-output systems, direct I/O, parallel I/O systems serial I/O systems. Sinking and sourcing. Discrete input module. Rectifier with filter, threshold detection, Isolation, logic section, specifications of discrete input module, types of analog input module, special input modules, analog output module, **SCADA: D**efinition and history of Supervisory Control and Data Acquisition, typical Architecture, Communication Requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA. SCADA Architecture(First generation-Monolithic, Second Generation-Distributed, Third generation Networked Architecture), SCADA systems in operation and control of interconnected power system,	19

Text Book:

1. "PLC and Industrial application", Madhu chhanda Mitra and Samarjit Sengupta, Pernram international pub. (Indian) Pvt. Ltd., 2011.
2. Ronald L Krutz, "Securing SCADA System", Wiley Publication

Reference Books:

1. Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 3rd Edition.
2. John W Webb, Ronald A Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning, New Delhi, 5th Edition.
3. Stuart A Boyer, "SCADA Supervisory Control and Data Acquisition", ISA, 4th Revised edition

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: After completion of the course, student shall be able to:

CO 1: Understand numbering system, structure of a PLC, SCADA system, Input/output modules interfacing, components such as power supply, memory etc.

CO 2: Design ladder programs for the problems related to timers and counters and develop the ladder diagrams for various Boolean expressions.

CO 3: Analyze the comparative analysis of instructions including equality and non-equalities.

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PSO2, PSO3

BEEE0074: COMPUTER AIDED ELECTRIC MACHINE DESIGN

Objective: To expose the students to the key concepts of design of Transformer as well as three-phase induction motors.

Credits: 3 **L-T-P-J:3-0-0-0**

Module	Content	Teaching Hour
I	**Introduction:** Design strategy: Iterative process, selection of design variables, checking of performance parameters. Advantages: Prediction of performance from physical dimensions of machine. **Single and Three-phase Transformer Design:** Output equation, selection of specific loadings. Main dimension of core and shell types of transformer. Transformer windings, concentric, spiral, crossover and disc types of windings; sandwich types coil for shell type transformers. Calculation of operating characteristics: winding, resistance, leakage reactance, voltage regulation, losses and efficiency and no load current, calculation of temperature rise and design of tank and tubes. **Computer Aided Design:** Selection of design variables and performance constraints, Development of flow chart for transformer design incorporating performance constraints.	21
II	**Three-phase Induction Motor Design:** Output equation, selection of specific loadings. **Stator Design**: Calculation of stator turns per phase, selection of shape and number of slots, slot dimensions, length of mean turn. Design of air gap length. **Rotor Design**: Rules for selection of number rotor slots, design of rotor bars and end rings for cage type of rotor. Design of turn per phase for slip ring type rotor. **Calculation of operating characteristics**: Calculation of iron loss and no-load current, Calculation of mmf for air gap, stator core, stator teeth and mmf for rotor core. Calculation for rotor resistance for cage type and slip ring type of motors. Calculation of leakage reactance, total standstill impedance, short circuit current and short circuit power factor. **Computer Aided Design:** Development of flow chart for three-phase InductionMotor design incorporating performance constraints, design conforming to standard frames.	21

Text Books:

1. A. K. Sawhney: Electrical Machine Design, Dhanpat Rai and Sons.
2. S.K. Sen:Principles of Electrical Machine Design with Computer Programs, Oxford and IBH Pub. Company.

Reference Books:

1. M.G. Say: The Performance and Design of Alternating Current Machines,Sir IsaacPitman and Sons and The English Language Book Society.

Focus: This course focuses on Employability aligned with all COs.

Course Outcome*: After completion of course student will be able to*

- CO1: Explain the design details of single, three-phase transformers and three-phase Induction Motor.
- CO2: Develop flow chart for transformer and Induction motor design incorporating performance constraints.
- CO3: Calculate the operating characteristics of transformer and three-phase Induction Motor.
- CO4: Design single, three-phase transformers and three-phase Induction Motor.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO):

Cos	Pos/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO2
CO3	PO2, PO4, PSO3
CO4	PO2, PO4, PO5,PSO3

BEEE 0094 : WIND ENERGY CONVERSION SYSTEM

Objective: *To make students familiar with the technology, grid integration and energy assessment for the wind energy conversion system.*

Credits: 03 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**BASICS OF WIND ENERGY TECHNOLOGY** Wind statistics- Measurements and data Presentation, Historical developments, latest developments, Indian scenario and worldwide developments, present status and future trends. Wind turbine aerodynamics. **CHARACTERISTICS OF WIND ENERGY** Nature of atmospheric winds- Wind resource characteristics and assessment–Anemometry, speed frequency distribution, effect of height, wind rose, Weibull distribution, atmospheric turbulence, gust wind speed, effect of topography. effect of Reynolds's number, actuator disc, Betz coefficient, design of wind turbine blade, effect of stall and blade tip speed ratio and coefficient of torque. **WIND ENERGY CONVERSION SYSTEM (WECS)** Rotor Selection, Annual Energy Output, HAWT, VAWT, Rotor Design Considerations-Number of Blades, Blade Profile -2/3 Blades and Teetering, Coning-Upwind/Downwind, Power Regulation, Yaw System- Tower, Synchronous and Asynchronous Generators and Loads.	22
II	**VARIABLE SPEED SYSTEMS** Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequencysystems synchronous generator- DFIG- PMSG -Variable speed generators modeling- Variable speedvariable frequency schemes. **GRID CONNECTED SYSTEMS** Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of thepower system including modeling issue.	20

Text Books:

- Steve Parker, "Wind power", Gareth Stevens Publishing, 2004.
- Freris L.L., Wind Energy Conversion Systems, Prentice Hall 1990.

- Spera D.A., Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering, ASME Press, NY 1994.

Reference Books:

- L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990
- S.N.Bhadra, D.Kastha,S.Banerjee,"Wind Electrical Sytems",Oxford University Press,2010.
- Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
- E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge,1976.
- N. Jenkins," Wind Energy Technology" John Wiley & Sons,1997
- S.Heir "Grid Integration of WECS", Wiley 1998.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1:Understand the existing Wind Energy Conversion System and wind energy potential and application of wind energy with case studies and its environmental impacts.

CO2: Understand the Grid connected system for Wind Energy Conversion System

CO3: Analyze the various aerodynamic loads and its design criterion on wind turbine system and the control mechanism of wind turbine.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO3 /PSO1, PSO2
CO2	PO1,PO2,PO3 /PSO1, PSO2
CO3	PO1,PO2,PO3 /PSO2, PSO3

BEEE 0870: ELECTRIC DRIVES LAB

Objective: *To develop a basic understanding and control of AC and DC machine using power electronic converters.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Lab Hours
I&II	1. To study speed control of separately excited dc motor by varying armature voltage using single-phase fully controlled bridge converter. 2. To study speed control of separately excited dc motor using single-phase dual converter (Static Ward-Leonard Control). 3. To study speed control of separately excited dc motor by varying armature voltage using single phase half controlled bridge converter. 4. To study closed loop control of separately excited dc motor. 5. To study speed control of separately excited dc motor using MOSFET/IGBT chopper. 6. To study speed control of single-phase induction motor using single phase ac voltage controller. 7. To study speed control of three phase induction motor using three phase ac voltage controller. 8. To study speed control of three phase induction motor using three phase current source inverter. 9. To study speed control of three phase induction motor using three phase voltage source inverter. 10. To study speed control of three phase slip ring induction motor using static rotor resistance control using rectifier and chopper. **Simulation Based Experiments (using MATLAB/ Simulink)** 11. To study transient response of separately excited dc motor. 12. To study speed control of separately excited dc motor using single phase full / half controlled bridge converter in discontinuous and continuous current modes. 13. To study speed control of separately excited dc motor using chopper control in motoring and braking modes. 14. To study transient response of three phase induction motor. 15. To study speed control of three phase induction motor using (a) constant/V/F control (b) constant voltage and frequency control.	24

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *On successful completion of the program, the student will be able to:*

1. Articulate power electronics applications in control of speed, torque and other components of motor.
2. Simulate the transient response and speed control of DC and AC Machine.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3

BEEE0053: BIOMEDICAL INSTRUMENTATION

Objective: *The course is aimed at giving the students an understanding of the human physiology and the various kinds of measurements involved in it.*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Brief description of cardiovascular, neuronal, respiratory and muscular systems and origin of bio-potential—action potential and resting potential **Bio-electrical signals:** (ECG, EEG, EMG, EOG & ERG) and their characteristics Different types of electrodes for the measurement of ECG, EEG & EMG signals; electrodes tissue interface; contact impedance and its effects. **Cardiovascular system measurements**: measurement of blood flow, volume of blood, cardiac rate, heart sound, hemoglobin, blood glucose **Neuromuscular system measurements:** of neuron potential & muscle potential **Respiratory system measurements:** measurement of CO_2& oxygen concentration in exhaled air.	21
II	**Prosthetics and Therapeutic devices:** artificial heart, artificial kidney, limb prosthetics cardiac pacemakers, defibrillators, ventilators, muscle stimulators, hearing and retinal implants. **Patient monitoring system:** X-ray machine-different types, basic components; intelligent monitoring system—CT scan, MRI, ultrasonography, thermography endoscopy. **Role of laser and microprocessor in health care** **Safety measures:** physiological effects of electricity, shock hazards	21

Text Book:

1. Geddes, L.A and Baker, L. E, Principles of Applied Biomedical Instrumentation, John Wiley & Sons (1989)

References:

1. Cromwell, L, Weibell, F.J and Pfeifer, E. A, Biomedical Instrumentation and Measurements, PHI (2003)
2. Khandpur, R. S, Handbook of Biomedical Instrumentation, 2nd Ed, Tata McGraw Hill (2008)
3. Webster, J. G, Medical Instrumentation-Applications and Design, 3rd Ed. Wiley India(2009)
4. Singh, M, Introduction to Medical Instrumentation, PHI Learning (2010)

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1. Understand the physiology of biomedical system, important body parameters and their implications.
CO2. Understand the working principle of patient monitoring system such as X-ray machine, CT scan, MRI, etc.
CO3. Demonstrate the application of ventilators, defibrillators in diagnostics and therapeutic area and modern technology in health care and safety measures.
CO4. Classify various bio-electric signals and the electrodes associated with them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2, PO5, PO6/ PSO1, PSO3
CO3	PO1, PO3, PO5, PO6/PSO2, PSO3
CO4	PO1,PO2, PO3/PSO1, PSO2, PSO3

BEEE0076: Electric Vehicles

Objective: *The objective of this is to introduces the concepts, principles, analysis and design of electric and hybrid electric vehicles*

Credits: 04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Electric and Hybrid Electric Vehicles** Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains **Energy storage:** Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors **Power Electronic Converter:** Battery Charging Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, High-frequency transformer based	21
II	**Electric Propulsion** EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives **Design of Electric and Hybrid Electric Vehicles** Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design	21

Text Books:

1. Ali Emadi, "Advanced Electric Drive Vehicles" Published by CRC Press April 21, 2017

Reference Books:

1. John G. Hayes, G. Abas Goodarzi, "Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles" John Wiley & sons Publishers Ltd 2018
2. Mi.Chris, M. Abul Masrur, "Hybrid Electric Vehicles : Principles and Applications with Practical Perspectives" ,2nd Edition John Wiley & sons Publishers Ltd 2017.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1. Understand working of Electric Vehicles and its performance parameter
CO2.Model and Analyze the energy storage for EV and HEV application
CO2. Analyze different power converters topologies used for electric vehicle application
CO4. Develop the electric propulsion unit and its control for EV/HEV applications

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3

BEEE0090: Introduction to Renewable Energy Technologies

Credits: 03 **L-T-P-J:3-0-0-0**

Module	Content	Teaching hours
I	Introduction to world energy scenario, Renewable energy resources, Radiation, Solar Geometry, radiation models; Solar Thermal, Optical efficiency, thermal efficiency, concentrators, testing procedures. Introduction to thermal systems (flat plate collector), solar architecture, solar still, air heater, panel systems; Photovoltaic	20
II	Introduction to semiconductor physics, doping, P_N junction, Sola r cell and its I_V characteristics, PV systems components, design of a solar PV systems. Biomass, Biomass resources, wood composition, pyrolysis, gasifies, biogas, biodiesel, ethanol; Wind, Introduction, types of wind machines, Cp- λ curve &betz limits, wind recourse analysis; Systems, stand alone, grid connected, hybrid, system design; Hydro systems , Hydro resources, types of hydro turbine, small hydro systems; Other systems, Geothermal, wave energy, ocean energy.	22

TEXTBOOKS

1. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi, 1996
2. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, second edition, John Wiley, New York, 1991

REFERENCES

1. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000
2. D. D. Hall and R. P. Grover, Biomass Regenerable Energy, John Wiley, New York, 1987.
3. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986.
4. M. A. Green, Solar Cells, Prentice-Hall, Englewood Cliffs, 1982.

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: After the completion of this course, students shall be able to

CO1: Recognize the need of renewable energy technologies and their role in global energy demand.
CO2: Choose the conventional and non conventional energy sources.
CO3: Compare the resources and working mechanism for renewable energy sources.
CO4: Assess the resources for appropriate site selection for power generation.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO1, PSO2
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEE0100: Illumination Science & Engineering

Objective: *The course is aimed at giving the students an understanding of several kinds of lighting sources & systems and its electrical control.*

Credits:04 **L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	**Importance of Lighting in Human Life:** Optical systems of human eye, Dependence of human activities on light, performance characteristics of human visual system, Radiant energy and visible spectrum, energy conversion to light, External factors of vision-visual acuity, contrast, sensitivity, time illuminance, colour, visual perception, optical radiation hazards, Good and bad effects of lighting & perfect level of illumination. **Lighting Systems:** Daylight, incandescent, electric discharge, fluorescent, arc lamps and lasers; Energy efficient lamps; Artificial lighting as substitute to natural light. **Light sources and their assets:** Laws of illumination, polar, curves, photometry, photocells. Environment and glare.General illumination design, Illumination levels, loss factors, lamp selection and maintenance, types of lamps, lamp fittings, Light control, design aspects of indoor and outdoor lighting	21
II	**Electrical Control of Light Sources:** Ballast, ignitors and dimmers for different types of lamps. Ability to control natural light, Production of light, physics of generation of light, Properties of light, Quantification & Measurement of Light, Luminaries, wiring, switching and control circuits. Interior lighting Design: Industrial, residential, office departmental stores, indoor stadium, theatre and hospitals. **Exterior lighting Design:** Flood, street, aviation and transport lighting, lighting for displays and signalling - neon signs, LED-LCD displays beacons and lighting for surveillance. Energy Conservation codes for lighting; lighting controls-daylight sensors and occupancy sensors; controller design. Special Features of Aesthetic Lighting	21

Text Book:

1. H. S. Mamak, "Book on Lighting", Publisher International lighting Academy
2. Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher -York, PA: Visions Communications
3. M. A. Cayless, A. M. Marsden, "Lamps and Lighting", Publisher-Butterworth-Heinemann(ISBN978-0-415-50308-2)
4. Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002
5. John Matthews Introduction to the Design and Analysis of Building Electrical Systems, Springer, 1993

Reference Books:

1. "BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting", Manak Bhavan, New Delhi
2. D. C. Pritchard, "Lighting", 4th Edition, Longman Scientific and Technical, ISBN 0-582-23422-0
3. "IES Lighting Handbook", (Reference Volume 1984), Illuminating Engineering Society ofNorth America.
4. "IES Lighting Handbook", (Application Volume 1987), Illuminating Engineering Society ofNorth America
5. IESNA lighting Handbook., Illuminating Engineering Society of North America 9th edition2000
6. Applied Illumination Engineering, Jack L. Lindsey FIES (Author), Scott C. Dunning PHD PECEM (Author) ,ISBN-13: 978-0824748098 ISBN-10: 0824748093, 3rd Edition.IS 3646: Part I: 1992, Code of practice for interior illumination.
7. Organic Light Emitting Diodes (OLEDs): Materials, Devices and Applications, Alastair Buckley,University of Sheffieid, UK, ISBN: 978-0-85709-425-4.

Focus: This course focuses on Employability aligned with all COs.

Outcome*: After completion of course, the student will be able to:*

CO1. Understand the concept of illumination, lighting systems, lighting sources and exterior security lighting systems.

CO2. Compare various lighting systems and their inherent properties working in the narrow range of wavelengths from 380 nm to 730 nm.
CO3. Compute various parameters of photometric light sources, laws of illumination, photometry etc.
CO4. Design modern lighting sources and controls for energy efficient lighting and a smart control drive circuit.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3/ PSO1
CO2	PO1, PO2, PO3, PO4, PO6/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PO6/PSO2
CO4	PO1,PO2,PO3, PO4, PO5, PO6, PO7/ PSO2, PSO3

BEEE0112: DIGITAL SIGNAL PROCESSING

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hour
I	Review of discrete time signals and systems, Sampling of CT signals: Periodic sampling, Frequency domain representation of sampling, Reconstruction of bandlimited signal from its samples, Discrete time processing of continuous time signals, Continuous discrete time signals, Changing the sampling rate using discrete time processing. Discrete time systems: Linear time invariant discrete time systems, Characterization of LTI systems. Transform domain representation of signals and systems: The discrete time Fourier transform, the frequency response, the transfer function, Discrete Fourier series, Discrete Fourier transform, Computation of DFT	21
II	Linear convolution using DFT, FFT Algorithms, Direct Computation of the DFT Radix-2 FFT algorithms, Gortezel Algorithm, Chirp Z-transform The z-transform, The region of convergence of z-transform Structures for discrete time systems: Block diagram and signal flow representation of constant coefficient, linear difference equation, Basic structures for IIR systems, Basic structures for FIR systems, Lattice structures, Effects of coefficient quantization, Effect of roundoff noise in digital filters, Zero-input limit cycles Filter design techniques: Design of discrete time IIR filters from continuous time filters, Design of FIR filters by windowing, Optimum approximation of FIR filters, Linear phase filters.	21

Text book:

1. Oppenheim & Schafer, "Digital Signal Processing" PH

References:

1. John G Prokias, Dimitris G Manolakis, "Digital Signal Processing", Pearson Education.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: After completion of course, the student will be able to:

1. *Understand the basic discrete-time signals and systems, concepts of continuous time sampling, convolution sum, impulse and frequency response concepts for linear, time-invariant (LTI) systems, difference equation realization of LTI systems and discrete-time Fourier transform and basic properties of these.*
2. *Compute Discrete Time Fourier Transform, Discrete Fourier Series and Discrete Fourier Transform, linear convolution using DFT. FFT algorithms, z- Transform and its region of Convergence, etc.*
3. *Analyze the effects of coefficient quantization, round-off noise in digital filters and limit cycles.*
4. *Build discrete time system structures for IIR and FIR systems such as Direct-I, Direct-II, lattice structures, etc.*
5. *Design discrete time IIR and FIR filters using different approaches.*

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1, PSO2
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PO5/ PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PO5/ PSO2, PSO3
CO5	PO1, PO2, PO3, PO4, PO5/ PSO2, PSO3

BEEO 0092: NON CONVENTIONAL ENERGY RESOURCES

Open electives offered by EE dept. for ME, CS, EC & CE

Credits: 04 **L–T–P-J: 4–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction Various non-conventional energy resources-** Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. solar cell materials, solar cell power plant, limitations. **Solar Thermal Energy:** Solar radiation flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **Geothermal Energy:** Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.	20
II	**Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations. Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations. Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. **Wind Energy:** Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics**.** Performance and limitations of energy conversion systems**.** **Bio-mass:** Availability of bio-mass and its conversion theory. **Ocean Thermal Energy Conversion (OTEC)**: Availability, theory and working principle, performance and limitations. **Wave and Tidal Wave**: Principle of working, performance and limitations. Waste Recycling Plants.	20

Text Book:

1. B. H. Khan "Non-Conventional Energy resource" second edition Tata McGraw-Hill Education Private Ltd.

References Books:

1. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
2. F.R. the MITTRE, "Wind Machines" by Energy Resources and Environmental Series.
3. Frank Kreith, "Solar Energy Hand Book".

Focus: This course focuses on Employability aligned with COs.

Outcomes: *On successful completion of the program, the students will be able to*

- ❖ *CO1: Explain the need of green energy sources across the domains.*
- ❖ *CO2: Compare the resources and working mechanism of various renewable energy techniques.*
- ❖ *CO3: Acquired skills in the scientific and technological communications, and in the preparation, planning and implementation of energy projects.*
- ❖ *CO4: Analysis and design of renewable energy source for a site.*

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO1, PSO2
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEE0037: COMPUTER METHODS IN POWER SYSTEMS

Objective: *To introduce computer applications in the analysis of power systems and to understand the solution methods and techniques used in power system studies.*

Prerequisite: Power System Analysis (BEEC0013)

Credits: 04 **Semester VII** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Topological Analysis of Power Networks:** Introduction, Primitive Impedance and Admittance Matrices, System Graph for Transmission Network, Transmission Network Representations, Network Matrices, Network Reduction. **AC Power Flow analysis:** Power Flow Equations, Gauss-Seidel Method, Newton Raphson Load Flow Method, Decoupled and Fast Decoupled Load Flow Method. **Optimum Power Flow:** Classical Method of Economic Load Dispatch with and without Considering Losses, Derivation of Loss-Formula, Optimal Power Flow.	20
II	**Fault Analysis in Large Power System:** Introduction, Formulation of Z_{BUS} Types of Faults, Symmetrical and Asymmetrical Faults, Short Circuit Analysis in a Large PowerSystems using Z_{BUS}, Analysis of Open Circuit faults. **Security Analysis:** Introduction, static security analysis, concept of linear sensitivity factors: Generation outage sensitivity factor (GOSF), Line outage sensitivity factor (LOSF), DC Load Flow, Contingency Analysis, Analysis of multiple contingencies, Contingency ranking and selection. **Stability Analysis:** Classification of power system stability, equation of motion of a synchronous generator, Representation of Generators and loads for transient stability analysis, Transient stability analysis of Multi-Machine Systems.	20

Text Book:

- G.W. Stagg & A.H. El-Abiad,'Computer Methods in Power System Analysis', Mc-Graw Hill, 1988.
- Haadi Saadat, 'Power System Analysis', Mc-Graw Hill, 2010.

References:

- John J. Grainger and William D. Stevenson Jr., 'Power System Analysis', Mc-Graw Hill, 2011.
- M A Pai and Dheeman Chatterjee, 'Computer Techniques in Power System Analysis', Mc-Graw Hill, 2017.
- A.R. Bergen and Vijay Vittal, 'Power Systems Analysis',Pearson Education Asia, 2001.
- J.D. Glover, M. Sharma and T.J. Overbye, 'Power SystemAnalysis and Design', Fourth Edition, ThomsonEngineering Press, 2008.

Focus: This course focuses on Employability aligned with all COs.
Outcome: *On successful completion of the program, the student will be able to:*

1. *Understand the modeling issues and analysis methods for the power flow, short circuit, contingency and stability analysis, required to be carried out for the power systems.*
2. *Determine the operating conditions of a system according to the demand without violating the technical and economic constraints.*
3. *Evaluate the effect of outage of any important component of power system on the operation and reliability of power systems.*
4. *Analyze the solution methods used in power system studies.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PSO1
CO2	PO1, PO2, PO3, PSO3
CO3	PO1, PO2, PO3, PSO3
CO4	PO2, PO3, PO4, PSO3

BEEE0099: Design and Installation of Solar PV System

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	Overview of Photovoltaics, Photovoltaic Electric Principles, The Solar Resource. , Electric Load Analysis. , Photovoltaic Modules, Batteries. PV Controllers, Inverters, Photovoltaic System Wiring, Sizing Stand-alone Photovoltaic Systems.	14
II	Grid-tied Photovoltaic, Systems, Mounting Photovoltaic Modules. Photovoltaic Applications for the Developing World, Photovoltaic System Installation, Maintenance and Troubleshooting, Safety and PV Installation.	14

Text Book:

1. Chetan Singh SolankiSolar Photovoltaics: Fundamentals, Technologies And Applications 3rd Edition, Kindle Edition
2. A Design Handbook for Architects and Engineers International Energy Agency, Paris, France Principal Editors: Friedrich Sick Thomas ErgeFraunhofer Institute for Solar Energy Systems (FhG-ISE) Freiburg, German Publishing Company.

Reference Books:

1. Chetan Singh Solanki "Solar Photovoltaic Technology and Systems": A Manual for Technicians,Trainers and Engineers Kindle Edition, PHI 2016

Outcomes: Students will be able to -

1: Critically assess solar photovoltaic system applications in the benefit of society.
2: Analyze solar photovoltaic system energy and building resources.
3: Design of solar photovoltaic systems.
4: Evaluate the performance with maintenance of faults in the system.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO1, PSO2
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEJ0986: Project Based on Design and Installation of solar PV system

Credits: 2 **L-T-P-J: 0-0-0-8**

List of Projects

1. Development of models for Solar resources monitoring and assessment on hourly basis
   In this projects students use Pyranometer for real time solar radiation measurement then based on used data set new approaches will be developed for forecasting the solar radiation.

2. Control strategy for self-healing of the off grid system
   In the current scenario of increased application of off grid solar PV system, its self-healing is important for the stability as well as maximum utilization to achieve high PR value

3. Policies for maximizing the skilled human resource
   To cooperate with the government initiative, based on regional requirement policies can be developed by the students to train the people of same area

4. Solar PV array fed induction motor for pumping applications at large level

5. Analysis of risk factor involves in solar projects funding and their mitigation

6. Solar PV Array fed indirect vector control of induction motor for pumping applications

7. Power Quality issues due to solar integration in GLA university Mathura distribution system.

8. Solar irradiance prediction using deep learning

*__The project list can change as per the industry requirement__

BEEE00852: COMPUTER METHODS IN POWER SYSTEMS LAB

Objective: *To introduce computer applications in the analysis of power systems and to understand the solution methods and techniques used in power system studies.*

Pre/Co-Requisite: Power System Analysis (BEEC0013)/BEEE0037

Credits: 01 **L–T–P: 0–0–2**

Module No.	Contents	Lab Hours
I,II	MATLAB/ETAP Based Experiments - 1. To formulate Y Bus matrix for a given power system. 2. To formulate Z Bus matrix for a given power system. 3. To perform the load flow analysis using Gauss Seidel Method. 4. To perform the load flow analysis using Newton-Raphson Method. 5. To perform the load flow analysis using Fast Decoupled Method. 6. To perform optimal load dispatch of generators using analytical and graphical method. 7. To obtain the equations describing the motion of the rotor angle and the generator frequency for a given power system. 8. Determine the critical clearing angle and the critical fault clearing time when a 3-phase fault occurs at the sending end of the line. 9. Determine the critical clearing angle and the critical fault clearing time when a 3-phase fault occurs at the middle of the line. 10. To conduct short circuit analysis for a given power system. 11. To carry out security analysis for a given power system.	24

Focus: This course focuses on Employability aligned with all COs.
Outcome: *On successful completion of the program, the student will be able to:*

1. *Implement the algorithms required to find out parameters for monitoring and control of power system in real time from actual measurement data.*
2. *Apply computer algorithms, used to solve algebro-differential pertaining to power system, to assess the stability performance of power systems in MATLAB/ETAP environment.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO3
CO2	PO2, PO3, PO4, PSO2

BEEE 0072: ELECTRIC DRIVES

Objectives:

- To learn the fundamental concepts of dynamics and control of Electric Drives.
- To study the criterion for selection of drives for various applications.
- To study the traditional methods of speed control.
- To learn the static control of DC and AC Drives.

Credits: 03 **L–T–P-J: 3–0–0-0**

Module	Content	Teaching Hour
I	**Types of Drives and Loads**: Classification of electric drives, comparison with other types of drives. Characteristics of different types of mechanical loads, stability of motor-load systems. **Selection of Motor Power Rating:** Thermal loading of motors, estimation of motor ratings for continuous, intermittent and short time duty loads. Fluctuating loads and load equalization. **Classical Methods of speed control:** Speed control of d.c. motors: rheostatic, field and armature control methods. Speed control of induction motors: stator voltage control, frequency control, pole changing and rotor resistance control methods. **Static Control of D.C. Drives**: Phase control of fully controlled dc drives: continuous and discontinuous conduction modes of operation.	21
II	Chopper controlled drives: TRC and CLC controls, continuous, discontinuous and critical conduction modes of operation. Closed loop control of d.c. drives: phase and chopper controlled drives. Electric braking of d.c. drives. **Static Control of A.C. Drives**: Static stator voltage control, variable frequency Constant volts/Hertz control, slip power recovery schemes. Method of voltage injection in rotor circuit. Introduction to vector control. Closed loop control of induction motor drives: VSI control, static rotor resistance control, Electric braking of induction motor drives.	20

Text Book:

1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House New Delhi, 2010.
2. S. K. Pillai, "A First Course on Electric Drives", New Age Publication 2012.

Reference Books:

1. Vedam Subrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill 2010.
2. Bimal K. Bose, "Modern Power Electronics and A.C. Drives", Pearson Education, India 2003.
3. Joseph Vithayathil, " Power Electronics, Principles and Applications", McGraw Hill, Inc 2010.
4. R. Krishnan," Electric Motor & Drives: Modeling, Analysis & Control, PHI Pvt. Ltd. 2001.

Focus: This course focuses on Employability aligned with all COs.

Course Outcomes: After learning the course the students should be able to:

CO1: Understand the basics of Speed–torque characteristics of electrical machines, static devices, and closed-loop control.
CO2: Compute the thermal heating and cooling time constants of electric drives.
CO3: Analyze the static control of DC and AC drives; and electric braking of drives.
CO4: Design the phase-controlled, chopper-controlled, and closed-loop controller of DC and induction motor drives.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, / PSO1
CO2	PO1, PO2/ PSO1, PSO2
CO3	PO1, PO2, PO3, /PSO2, PSO3
CO4	PO1, PO2, PO3/ PSO2, PSO3

BEEJ0966: Electric Vehicles Project

Objective: The objective of the project is to develop the analysis and design of electric and hybrid electric vehicles in any of one domain mentioned in the list.

Credits:02 **L-T-P-J:0-0-0-8**

Module No.	Content	Teaching Hours
I	**Student may choose any project from the mentioned domain:** **1.** Modelling of a Hybrid Electric Vehicle using ADVISOR ADVISOR can be used for the analysis of performance, fuel economy, and emissions of conventional, electric, hybrid electric, and fuel cell vehicles. The backbone of the ADVISOR model is the Simulink block diagram. In the project student will model and simulate the performance of different hybrid energy sources for hybrid vehicle. **2.** Control Strategy of Hybrid Fuel Cell Power System Fuel cell is used as main source in electric vehicle. This project will focus on control strategy of fuel cell for steady state load current at load transient. **3.** Electric Rikshaw Range Modelling The project will focus on modelling & simulation of range for the commercially available E-Riakshaw and compare the results with E-Rikshaw available with GLA University. **4.** Modelling of Transmission System In HEV, the transmission system perform the task which controls the direction and amount of power flow on the vehicle so as the overall efficiency of a hybrid vehicle is improved. The project will focus the modelling of transmission system in MATLAB.	24

Focus: This course focuses on Employability aligned with COs.

Outcome: After completion of course, the student will be able to:

CO1: Model and Analyze the various components used in EV/HEV

CO2: Analyze the performance of vehicle

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3

BEEE0851: INTELLIGENT TECHNIQUESIN ELECTRICAL ENGINEERING LAB

Objective: *To develop a basic understanding of Artificial intelligence techniques, and their applications to Electrical Engineering and to provide motivation to design intelligent systems and control. Computer simulation of intelligent control systems to evaluate the system performance.*

Pre/Co-Requisite:*BEEE0036*

Credits: 01 **L–T–P: 0–0–2**

Module No.	Contents	Lab Hours
I	1. To study MATLAB tools for Neural Networks. 2. To study MATLAB tools for Fuzzy Logic. 3. To study MATLAB tools for Genetic Algorithm. 4. Training algorithms of neural networks and fuzzy logic 5. Implementation of fuzzy logic, Neural networks and genetic algorithms on various applications.	24

Focus: This course focuses on Employability aligned with all COs.
Outcome: *On successful completion of the program, the student will be able to:*

1. *Implement neural networks and fuzzy logic for classification, control system and optimization problems.*
2. *Simulate the fuzzy controllers using intelligent algorithms in MATLAB environment.*
3. *Obtain the optimum solution of well formulated optimization problem using Genetic Algorithm.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PSO2
CO2	PO1, PO2, PO3, PSO2
CO3	PO1, PO2, PO3, PO5, PSO3

BEEE0036: INTELLIGENT TECHNIQUESIN ELECTRICAL ENGINEERING

Objective: *To develop a basic understanding of Artificial intelligence techniques, and their applications to Electrical Engineering and to provide motivation to design intelligent systems and control.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Motivation, Rationale for using Artificial Intelligence (Neural Network, Fuzzy, Evolutionary Computation) in Engineering. **Artificial Neural Network:**Concept of Artificial Neural Networks (ANN), Adaline, Linear Separable Patterns, Single Layer Perceptron, Multilayer Perceptron,Neural Network (NN) architecture, NN Classifications, Back Propagation Algorithm, Radial Basis Function Network (RBFNN), Applications of ANN. **Fuzzy Logic**:Introduction, Classical Sets, Classical Sets Operations, Properties of Classical Sets, Fuzzy Sets, Fuzzy Membership Functions, Fuzzy Set Operations, Properties of Fuzzy Sets, Alpha-Cut Fuzzy Sets, Extension Principle.	21
II	**Fuzzy Logic:**Fuzzy Measures, Measures of Fuzziness, Classical Relations vs. Fuzzy Relations, Predicate Logic, Fuzzy Logic, Approximate Reasoning, Fuzzy Rule Based System, Fuzzy Logic Controller, Applications of Fuzzy Logic. **Evolutionary Computation:** Introduction to Evolutionary algorithms, Genetic Algorithm (GA), solution, initial population, genetic operators, fitness function, stopping condition, fitness scaling, rank scaling, proportional scaling, top scaling, selection, Roulette Wheel selection, stochastic universal sampling, rank selection, tournament selection, other selection methods, mutation, uniform mutation, Gaussian mutation, variable mutation rate, crossover techniques, other genetic operators, Generation Gap, Elitism, Duplicates, Genetic Search, Genetic Programming, Applications of GA.	21

Text Book:

- Ali Zilouchian, Mo Jamshidi, “Intelligent control systems using soft computing methodologies”, CRC Press, 2001.
- James M. Keller, Derong Liu, David B. Fogel, “Fundamentals of Computational Intelligence. Neural Networks, Fuzzy Systems, and Evolutionary Computation”, Wiley, 2016.
- Chennakesava R. Alavala, “Fuzzy Logic and Neural Networks-Basic Concepts and Applications” New Age Publications (Academic), 2008.

Reference Book:

- Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley India, 2010.
- AnupamShukla, RituTiwari, Rahul Kala, “Real Life Applications of Soft Computing”, CRC Press, T & F Group, 2010.
- Kevin M. Passino and Stephen Yurkovich, “Fuzzy Control”, Addison Wesley Longman, Menlo Park, CA, 1998.
- Kevin Warwick, Arthur Ekwue and Raj Aggarwal, “Artificial Intelligence Techniques in Power Systems”, Institution of Engineering and Technology, London, UK, 1997.

Focus: This course focuses on Employability aligned with all CO3, CO4 and CO5.
Outcome: *On successful completion of the program, the student will be able to:*

1. *Understand the basics of Neural Network, Fuzzy and Evolutionary Computation.*
2. *Apply the neural networks for classification, control system and optimization problems.*
3. *Analyze the performance of optimization problem using Genetic Algorithm.*
4. *Design intelligent controllers for the given problem.*

5. *Formulate intelligent algorithms for typical electrical applications.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PSO1
CO2	PO1, PO2, PSO2
CO3	PO2, PO3, PSO3
CO4	PO3, PO4, PSO3
CO5	PSO3, PO3, PO5

BEEE0071: SPECIAL ELECTRIC MACHINES

Objective: *To make the student able to understand the constructional and operational working of the Single phase synchronous motor, stepper motor, two phase AC servomotor, single phase commutator Motors and linear induction motor.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Single Phase Synchronous Motor:** Construction, principle of operation and characteristics of: reluctance motors, hysteresis motors, switched reluctance motors. **Stepper Motors:** Construction and principle of operation of: variable reluctance, permanent magnet and hybrid stepper motors. **Permanent Magnet Machines:** Permanent magnet ac and dc motors: brushless dc motors and their important features and applications, PCB motors, introduction to permanent magnet generators.	21
II	**Two-Phase AC Servomotors:** Construction, torque-speed characteristic, performance and applications. **Single-Phase Commutator Motors**: Construction, principle of operation and applications of: universal motor, single phase a.c. series motor, repulsion motors. **Principle of voltage injection:** Principle of voltage injection in rotor circuit of slip ring induction motor: Schrage Motor. **Linear motors**: Construction and principle of operation of Linear induction motors.	21

Text Books:

1. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill.
2. J.B.Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons.
3. AshfaqHussain, "*Electric Machines*", Dhanpatrai and Sons.

Reference Books:

1. PenshawTaylor, "The Performanceand Design of A.C. Commutator Motors", A.H.Wheeler& Co.
2. Cyril G. Veinott , "Fractional and Sub-fractional horse power electric motors", McGraw Hill.
3. M.G. Say, "*The Performance and Design of AC machines*", Pit man & Sons.
4. A.E. Fitzgerald, C.KingsleyandUmans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill.
5. F.Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating CurrentMachines*", Asia Publishing House.

Focus: This course focuses on Employability aligned with all CO2, CO3 and CO4.

Outcome: After completion of course, the student will be able to:

1. *Understand the working principle of hysteresis motors, PCB motor,* permanent magnet generators *repulsion motor and linear induction motor.*
2. *Analyze the concept of speed control of permanent magnet dc motor, universal motor and Schrage motor.*
3. *Compute the various type of performance parameters of reluctance motor, stepper motors, permanent magnet dc motor, brushless dc motors and two-phase AC servomotor*.
4. *Apply concept of voltage injection method in 3 phase induction motor.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEE 0078: UTILIZATION OF ELECTRIC POWER & TRACTION

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Illumination engineering:** Nature of light, general terms used in illumination, sensitivity of the eye, production of light, incandescent lamps, arc lamps, gas discharge lamps-fluorescent lamps, comparison of magnetic and electronic ballast circuit, polar curves. Distribution and control of light, solid angle, inverse square and cosine laws, lighting calculations, methods of calculations, factory lighting, flood lighting and street lighting. **Refrigeration:** Electrical circuits used in domestic refrigerator. **Electrolysis:** Review of electrolytic principles, laws of electrolysis, current efficiency, energy efficiency, electrode position, anodizing, electroplating , extraction of metals, refining of metals. **Electric heating:** Electrical heating advantages, methods and applications, resistance heating, design of heating elements, induction heating, core type furnaces, core less furnaces and high frequency eddy current heating, dielectric heating, arc furnaces (direct arc furnaces, Indirect arc furnaces), electrodes, power supply and control.	21
II	**Welding:** Different methods of electrical welding, resistance welding, arc welding, laser welding, electron-beam welding and welding transformers. **Traction system:** Different system of electric traction and their advantages and disadvantages, Special features of traction motors, selection of traction motor, mechanics of train movement, simplified speed time curves for train movement, crest, average and schedule speed, tractive effort, specific energy consumption, adhesive weight and coefficient of adhesion. **Power supply for electric traction:** Conductor rail system, bow collector, pantograph collector, main parts of AC electric locomotive unit, use of boosters to minimize interference with communication lines **Applications:** Tramways, trolley bus, diesel electric traction.	21

Text Books:

1. H.Partab,"Art and Science of Electrical Energy" DhanpatRai& Sons publications.
2. J. B. Gupta, "Electrical Power Utilization" S.K.Kataria& Sons publication.

Reference Books:

1. S. Sivanagaraju, M. Balasubba Reddy & D. Srilatha, "Generation and Utilization of Electrical Energy", Pearson Publications.
2. N.V. Suryanarayana,"Utilization of Electric Power" Wiley Eastern publication.

Focus: This course focuses on Employability aligned with all COs.

Outcome: *After completion of course, student will be able to:*

CO1: *Explain application of electric power in Illumination, refrigeration, electrolysis, heating, welding and traction system.*

CO2: *Compare electrical characteristics of different illumines, heating and welding schemes*

CO3: *Analyze role of speed-time curves, tractive effort, specific energy consumption and power supply for an electric traction system*

CO4: *Design a heating element and lighting scheme for a given application*

CO5: *select a suitable motor for traction application*

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO1, PSO2, PSO3

BEEG0002/BEEE: ELECTRICAL TECHNOLOGY

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Power Generation** Power generation scenario in India, conventional generation and plant layout: Hydroelectric power generation, thermal power generation, Nuclear power generation, comparison. Renewable generation and system layout: photovoltaic generation, wind power, tidal power, geothermal power, fuel cell. Load curves, Important terms and factors: connected load, maximum demand, average load, load factor, diversity factor. **Economics of power generation:** fixed cost, semi fixed cost, running cost, Tariff: objective, desirable characteristics, types.	21
II	**Transmission and distribution:** Electric supply system layout, introduction to ac and dc transmission system, comparison, elements of transmission: power transformer, towers, insulators, conductors, cables, distribution transformer; requirements of satisfactory electric supply, overview of distribution system, challenges in power system. **Power factor improvement:** Power triangle, disadvantages of low power factor, causes of low power factor, power factor improvement method, calculation for power factor correction **Electrical loads:** Modelling of load, Electric lighting: Basic parameter used in lighting, various types of lighting sources: Fluorescent lamps, electrical circuitry, CFLs, LED lighting, Lighting design process, Electric Motor: load characteristics, gearing, various applications such as elevator, hybrid electric vehicle (HEV). Introduction to transducers and sensors.	22

Text Books:

1. Mehta V.K. & Mehta Rohit. Principles of Power System (Multicolor Edition).S. Chand, 2005 (illustrated, revised edition).
2. Gross, Charles A., and Thaddeus A. Roppel. Fundamentals of electrical engineering. CRC press, 2012.

Reference Books:

1. Bird, John. Electrical circuit theory and technology. Routledge, 2017
2. Hughes, Edward, et al. Hughes electrical and electronic technology. Pearson education, 2008.

Focus: This course focuses on Employability aligned with all COs.

Course Outcome: *at the end of course student will able to,*
CO1: Elaborate and compare conventional and renewable energy power generation.
CO2: Understand the terms as used in load curves.
CO3: Estimate cost of power generation and tariffs.
CO4: Identify role of various components involved in transmission and distribution of electrical power.
CO5: Understand the importance of power factor improvement.

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3
CO5	PO1, PO2, PO3, PO4 /PSO1, PSO3

BEEC0011: CONTROL SYSTEM

Credits: 4 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**The Control System:** Open loop & closed control, Servomechanism, Control System Physical examples. Transfer functions, Block diagram algebra, Signal flow graph, Mason's gain formula **Control System Components:** Constructional and working concept of ac servomotor, synchro. **Time Response analysis:** Time response of first and second order systems, time response specifications, steady state errors and error constants **Controller:** PID controller, performance indices, **Stability in Time Domain:** Concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations.	22
II	**Root Locus Technique:** The root locus concepts, construction of Root Loci **Frequency Response Analysis:** Frequency response, correlation between time and frequency responses. **Frequency Response Analysis:** Polar plots, Bode plots **Stability in Frequency Domain**: Nyquist stability criterion, assessment of relative stability, gain margin and phase margin **Introduction to Design:** The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in frequency domain**.** **Overview of State Variable Technique**. Overview of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability.	22

Text Books:

1. Nagrath I. J. &Gopal M, *"Control System Engineering"*, New age International. 6th edition (2017).
2. K. Ogata, "*Modern Control Engineering*", Prentice Hall of India. 5th edition (2010)

References:

1. Norman S. Nise, *"Control System Engineering",* Wiley Publishing Co. 8th edition (2019).
2. A. Anand Kumar, *"Control systems",* PHI learning private limited, 2nd Edition (2014)
3. B.C. Kuo & M. F. Golnaraghi, "*Automatic Control System*", Wiley India Ltd. 8th edition (2007)

Focus: This course focuses on Employability aligned with all COs.

Outcome: *After completion of course, students will be able to:*

CO1. Explain the meaning of control system, its types as well as treatment of special control system.
CO2. Solve the transfer functions of physical systems using block diagram reduction method or signal flow graph approach.
CO3. Understand time response and frequency response analysis and stability aspects of a system.
CO4. Implement different numerical and graphical stability technique to analyze the stability of control system.
CO5. Understand the overview and importance of time domain approach such as state variable technique in control system analysis.

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1,
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO1
CO5	PO1, PO2, PO3, PO4 /PSO1, PSO3

(M.TECH. COURSE STRUCTURE)

DEPARTMENT OF ELECTRICAL ENGINEERING

GLA UNIVERSITY, MATHURA (U.P.)

SEMESTER I
First year session 2019-20, 2020-21

SR. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT HRS/WK
			L	T	P		
1.	MEEC0001	Computer Aided Power system analysis	4	0	0	4	4
2.	MEEC1002	Power system Dynamics& Control	4	0	0	4	4
3.	MEEC0003	Advanced Electric Drives	4	0	0	4	4
4.	MEEC0004	Power Electronic Devices & Converters	4	0	0	4	4
5.	MEEC1005	Optimization Techniques	4	0	0	4	4
PRACTICALS							
6.	MEEC0800	Advanced Simulation Lab.	0	0	2	1	2
		Total	**20**	**0**	**2**	**21**	**22**

SEMESTER II

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
1.	MEEC0006	Analog & digital control system	4	0	0	0	4	4
2.	MEEC0007	Advanced Power System Operation & Control	4	0	0	0	4	4
3.	MEEC0008	Microcontroller and Application	4	0	0	0	4	4
4.	MEEE-	Professional Elective –I	4	0	0	0	4	4
5.	MEEE-	Professional Elective –II	4	0	0	0	4	4
6.	MEEJ0801	Minor Project	0	0	0	4	2	4
		TOTAL	20	0	0	4	22	24

SEMESTER III

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
1.	MEEE-	Professional Elective -III	4	0	0	0	4	4
2.	MEEE-	Professional Elective -IV	4	0	0	0	4	4
3.	MEEC0802	Seminar	0	0	4	0	2	4
4.	MEEJ0971	Dissertation-I	0	0	0	16	4	16
		TOTAL	20	0	0	16	14	28

SEMESTER IV

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
1.	MEEJ0972	Dissertation-II	0	0	0	56	14	56
		TOTAL	0	0	0	56	14	56

POWER ELECTRONICS & DRIVES

ELECTIVE I

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
1.	MEEE0041	Advanced Power Electronics	4	0	0	0	4	4
2.	MEEE0023	HVDC Transmission & Flexible AC transmission systems	4	0	0	0	4	4

ELECTIVE II

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
1.	MEEE0043	Solid State Control of Electric Drives	4	0	0	0	4	4
2.	MEEE0044	Power electronic circuit modeling & Simulation	4	0	0	0	4	4

ELECTIVE III

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
3.	MEEE0045	Introduction To Hybrid & Electric Vehicles- (Prerequisite Solid state control of drives)	4	0	0	0	4	4
4.	MEEE0046	High performance AC Drives Prerequisite – (Power Electronic circuit modeling and simulation)	4	0	0	0	4	4

ELECTIVE IV

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
1.	MEEE0047	Renewable & Distributed generation systems	4	0	0	0	4	4
2.	MEEE0048	Industrial drives & Automation (Prerequisite Power Electronic devices & converters)	4	0	0	0	4	4

POWER SYSTEM

ELECTIVE I

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
3.	MEEE0021	Power quality and conditioning	4	0	0	0	4	4
4.	MEEE0022	Electrical Insulation in Power apparatus & systems						
5.	MEEE0023	HVDC Transmission & Flexible AC transmission systems	4	0	0	0	4	4

ELECTIVE II

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
5.	MEEE0024	Power System Transients	4	0	0	0	4	4
6.	MEEE0025	Advance Protective Relaying	4	0	0	0	4	4

ELECTIVE III

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
7.	MEEE0026	Smart grid and phasor Measurement Techniques	4	0	0	0	4	4
8.	MEEE0027	EHV/UHV power transmission engineering (Prerequisite HVDC Transmission & Flexible AC transmission systems)	4	0	0	0	4	4

ELECTIVE IV

SR. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT HRS/WK
			L	T	P	J		
3.	MEEE0028	Power System Restructuring & Deregulation	4	0	0	0	4	4
4.	MEEE0029	Power system Planning & Reliability (Prerequisite Advance Protective relaying)	4	0	0	0	4	4

MEEC1002: POWER SYSTEM DYNAMICS& CONTROL

Objective:*The course aims to give basic knowledge about the power system dynamics and introduce & explain different stability issues in electric power system, including physical phenomenon, modeling issues and the stability improvement*

Module No.	Content	Teaching Hours
I	**Power System Stability:** Basic concept of power system stability, classification; Rotor angle, frequency, and voltage stability, mid-term and long-termstability and their impacts; Analysis of Dynamical Systems. **Modeling of power system components for stability analysis:** Modeling of Synchronous Machines, Modeling of Excitation and Prime Mover Systems, Transmission Lines and Loads.	18
II	**Stability Issues in Interconnected Power Systems:** Analysis of single-machine and multi-machine systems, Transient stability analysis; Small signal stability analysis; Introduction to sub synchronous resonance; Voltage stability analysis. **Enhancement of Power System Stability:** Planning Measures; Stabilizing Controllers (Power System Stabilizers and FACTS controllers); Operational Measures- Preventive Control, Emergency Control.	22

methods.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Text Books:
- L.P.Singh , "Power System Analysis & Dynamics", Wiley Eastern, Delhi.
- P. Saur & M.A. Pai, "Power System Dynamics & Stability", Prentice Hall.
- P.Kundur, "Power System Stability and Control", Mc-Graw Hill.

Reference Books:
- A.A. Foud& P.M. Anderson, "Power System Stability and Control," Vol. F. Latest Indian Edition, Galgotia Press, New Delhi.
- K.R.Padiyar, "Power System Dynamics Stability & Control", Interline Publishers, Bangalore.
- E.W.Kimbark,"Power System Stability",Wiley-IEEE Press.

C.P.Taylor, "Power System Voltage Stability", Mc-Graw Hill.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *At the end of the course, students will be able to –*
1. *Gather high-quality knowledge on stability, operation and control of power systems.*
2. *Analyze and understand the electromagnetic and electromechanical phenomenon taking place around the synchronous generator.*
3. *Identify and solve the stability related problems in power system.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2,

CO3	PO1, PO2, PO3, PSO3

MEEC0003: ADVANCED ELECTRIC DRIVES

Module	Content	Teaching Hours
I	**Introduction:** Basic drive components, advantages of electric drives,selection of electric drives for industrial applications. **Stability of Motor-Load Systems:** Review of speed-torque characteristics of electric motors, types of mechanical loads and their characteristics, determination of stability of motor-load systems,load equalization. **Estimation of Motor Power Rating:** Heating and cooling of electric motors, thermal loading of electric motors, estimation of rating of electric motors for continuous, short time and intermittent duty loads.	22

Objectives:*To introduce the basic concepts of load and drive interaction, speed control concepts of ac &dc drives, speed reversal, regenerative braking aspects & design methodology.*

Credits: 04 **Semester I** **L–T–P: 4–0–0**

II	**Energy conservation in Electric Drive:** Losses in electric drive system and their minimization, efficient operation of electric drives. **Electric Braking:** Advantages of electric braking, requirements of a good braking system, Methods of electric braking of electric motors: Plugging, dynamic and regenerative braking of dc and ac motors. **Traction Drive:** Electric traction services, speed-time curves of electric traction motors, train resistance, tractive effort, specific energy consumption, calculations of power rating of traction motor,control of traction motors.	22

Text Book:

- G.K. Dubey, "Fundamentals of Electric Drive" Narosa Publishing House .
- G.K.Dubey," Power Semiconductor Controlled Drives", Prentice Hall.
- S.K. Pillai, "A first course on Electric Drive", New Age International Publishers.

References:

- N.K. DE and P.K. Sen, "Electric Drives," Prentice Hall of India.
- Vedam Subramanyam, "Electric Drive: Concepts and Applications" Tata McGraw Hill.
- M. Chilkin, "Electric Drive", Mir Publications.

Focus: This course focuses on Employability aligned with all COs.

Outcome: *On successful completion of the program, the student will be able to:*

1. *Understand the modeling* Basic drive *components, advantages of electric drives.*
2. *Evaluate speed-torque characteristics of electric motors, types of mechanical loads and their characteristics.*
3. *Analyze the Heating and cooling of electric motors, thermal loading of electric motors.*
4. *Compare various methods of electric braking of electric motors.*
5. *Analyze speed-time curves of electric traction motors, train resistance, tractive effort, specific energy consume.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO1
CO3	PO1, PO2, PO3, PSO3
CO4	PO1, PO2, PO3, PSO3
CO5	PO2, PO3, PO4, PSO3

MEEC0004: POWER ELECTRONIC DEVICES & CONVERTERS

Objective: *The aim of this course is to present the concepts of typical power electronic circuits: topologies and control. Converter analysis, various semiconductor devices, modeling, design and control of converters will be presented as relevant to different applications.*

Credits: 04 | **Semester I** | **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Review of Power Electronic Converters:** Thyristor, GTO, MOSFET, BJT, IGBT and MCT; Drive circuit and switching network for power switching devices; Boost and buck converters using BJT and IGBT circuits; Thyristor and BJT based converter, phase control, effect on power factor, harmonics, inverter circuit using BJT and MOS devices; PWM technique for voltage and harmonic control **Switched Mode Power Supply:** Basic rectifier concepts of DC-DC converters and closed loop control; Resonant DC-DC converters: operating principle, waveforms, switching trajectory and losses and control; PWM inverter modulation strategies: sine wave with third harmonic	12
II	**space vector modulation** and predictive current control techniques, PWM rectifier; Three level inverter: basic topology and waveform, improvement in harmonics and high voltage application; Resonant ac link / dc link inverters **Cycloconverters**: Circuit, operating principle, control, harmonics, power factor and applications; Non-drive application of power electronic converters: back to back HVDC transmission, induction heating, electronic ballast, UPS, SVC and active filters. Industrial PWM driver chips for power supplies such as UC 3843, 3825 or equivalent.	24

Text Books:

- N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics, Converter, Application and Design", Third Edition, John Willey & Sons, 2004.
- M. H. Rashid, "Power Electronics, circuits, Devices and Applications", Pearson, 2002, India.
- Power Electronics Devices, Circuits and Industrial applications, V.R. Moorthi, Oxford University Press.

Reference Books:

- Power Electronics, Dr. P. S. Bimbhra, Khanna Pubishers.
- Elements of Power Electronics, Philip T. Krein, Oxford University Press.
- Power Electronics, M. S. Jamil Asghar, PHI Private Limited.
- Principles of Power Electronics John G. Kassakian, Martin F. Schlect, Geroge C.

Focus: This course focuses on Employability aligned with all COs.

Outcome: *On successful completion of the program, the student will be able to:*

6. *Understand the modeling issues and analysis Thyristor, GTO, MOSFET, BJT, IGBT and MCT; Drive circuit and switching network for power switching devices.*
7. *Understand the Basic rectifier concepts of DC-DC converters and closed loop control; Resonant DC-DC converters.*
8. *Analyze the behavior of system during switching trajectory and losses and control; PWM inverter modulation strategies: sine wave with third harmonic.*
9. *Understand the basic topology and waveform, improvement in harmonics and high voltage application.*
10. *Critically compare the Industrial PWM driver chips for power supplies such as UC 3843, 3825 or equivalent.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs

CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO1
CO3	PO1, PO2, PO3, PSO3
CO4	PO1, PO2, PO3, PSO3
CO5	PO2, PO3, PO4, PSO3

MEEC1005: OPTIMIZATION TECHNIQUES

Objective:*The objective of this course is to develop the basic understanding of optimization techniques to solve the real life problems. This course also covers non-traditional meta-heuristic optimization techniques.*

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Optimization:** Definition, classification of optimization problems, classical optimization techniques-single variable and multiple with and without constraints, Convex Programming Problem: feasibility and optimality conditions. **Linear Programming:**Geometry, Simplex method, Duality and Sensitivity, Interior Point methods, Transportation and Network Flow Problems. **Nonlinear Programming:** Single Variable- Elimination-Fibonacci and Golden search method, Interpolation methods-quadratic, cubic and direct root methods	18
II	**Nonlinear Programming:** Unconstrained n-dimensional Optimization-Introduction, Optimality conditions, Direct search methods-Random and Pattern Search methods and Indirect Search method- Steepest Descent. Newton's Method, Marquardt Method and Quasi Newton method, Constrained optimization-Introduction, Characteristics, Primal Methods, Penalty and Barrier Methods, Dual and Cutting Plane Methods **Integer Programming:** Integer Linear Programming-Graphical Representation, Cutting Plane method, Integer Nonlinear Programming-Branch-and-Bound Method, Sequential Linear Discrete Programming, Penalty Function method. **Meta Heuristic Techniques:** Simulated Annealing, Genetic Algorithm, Swarm based and other nature inspired optimization algorithms.	22

Text Books:

- David Luenberger and Yinyu Ye, Linear and Nonlinear Programming, 3rd Edition, Springer, 2008.
- Rao S. S., "Engineering Optimization: Theory and Practice", New Age International Pvt Ltd.
- Fletcher R., Practical Methods of Optimization, John Wiley, 2000.

References:

- Griva, Igor, Stephen G. Nash, and ArielaSofer. Linear and nonlinear optimization. Vol. 108. Siam, 2009.
- Mirjalili, Seyedali. "Evolutionary algorithms and neural networks." Studies in Computational Intelligence (2019).
- Goldberg, David E. Genetic algorithms. Pearson Education India, 2006.
- Eberhart, Russell, and James Kennedy. "A new optimizer using particle swarm theory." MHS'95. Proceedings of the Sixth International Symposium on Micro Machine and Human Science. IEEE, 1995.

Focus: This course focuses on Employability aligned with all COs.

Outcomes*: After going through this course, student will be able to*

1. *Identify different optimization problems.*
2. *Formulate mathematical models for single variable and multi-variable unconstrained and constrained optimization problems.*
3. *Apply the concept of optimality criteria for various optimization problems*
4. *Apply different optimization technique according to the problem for finding solutions of the optimization problems.*
5. *Solve the optimization problems using both traditional and non-traditional optimization techniques.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1

CO2	PO1, PO2, PSO1
CO3	PO1, PO2, PO3, PSO3
CO4	PO1, PO2, PO3, PSO3
CO5	PO2, PO3, PO4, PSO3

MEEC0001: COMPUTER AIDED POWER SYSTEM ANALYSIS

Objective: *To perform steady state analysis and fault studies for a power system and to explore the nuances of estimation of different states of power system.*

Credits:04 **SemesterI** **L-T-P-J:4-0-0-0**

Module No.	Contents	Teaching Hrs.
I	**AC Power Flow analysis:** Introduction,modelingofpowersystemcomponents,FormationofY-Bus and Z-Bus matrices. Power flow equations. Solution algorithm; Gauss- Seidel, Newton-Raphson, Decoupled and Fast Decoupled Load Flow. DC Load Flow. Comparison ofmethods. **Sparse Matrices:** Optimal ordering schemes. LU factorization and solution algorithms. **Fault Analysis:** Modeling of large interconnected power system for fault analysis in phase coordinates and symmetrical components. Generalized expressions for fault current and bus voltages during fault. Types offault and formation of three-phase Z_F& Y_F. Analysis of various faults.	24
II	**Contingency Analysis:** Introductiontocontingencyanalysisanditsnecessity.Operatingstatesof power system. Types of contingencies; network outage, power outage. Analysis of single and multiple contingencies. **State Estimation (SE) in Power Systems:** Introduction to SE in power system. The method of Weighted Least Squares,Statistics,ErrorsandEstimates, Testforbaddata,PowerSystem State Estimation. The structure and formation ofHessian. **Three Phase Load Flow:** Introduction to Three Phase Load Flow Analysis in Power System, Formation of three-phase Y-Bus. System modeling and power flow equations in three-phase. Solution Techniques. **Load Flow for Distribution System:** Introduction to radial and weakly meshed Distribution System, Load Flow using Forward/Backward sweep.	24

Text Book:

- G.W. Stagg & A.H. El-Abiad,'Computer Methods in Power System Analysis', Mc-Graw Hill, 1988.
- John J. Grainger and William D. Stevenson Jr., 'Power System Analysis', Mc-Graw Hill, 2011.
- Haadi Saadat, 'Power System Analysis', Mc-Graw Hill, 2010.

References:

- M A Pai and Dheeman Chatterjee, 'Computer Techniques in Power System Analysis', Mc-Graw Hill, 2017.
- A.R. Bergen and Vijay Vittal, 'Power Systems Analysis',Pearson Education Asia, 2001.
- J.D. Glover, M. Sharma and T.J. Overbye, 'Power SystemAnalysis and Design', Fourth Edition, ThomsonEngineering Press, 2008.
- William H. Kersting, 'Distribution System Modeling and Analysis', CRC Press, Taylor & Francis Group, 2018.

Focus: This course focuses on Employability aligned with all COs.

Outcome:*On successful completion of the program, the student will be able to:*

1. *Understand the modeling issues and analysis methods for the power flow, fault analysis, contingencyanalysis, required to be carried out for the power systems.*
2. *Understand the three-phase load flow and distribution system load flow.*
3. *Analyze the behavior of system during short circuit and the importance of contingency analysis.*
4. *Evaluate the effect of outage of any important component of power system on the operation and reliability of power systems.*
5. *Critically compare the solution methods used in power system studies.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO1
CO3	PO1, PO2, PO3, PSO3
CO4	PO1, PO2, PO3, PSO3
CO5	PO2, PO3, PO4, PSO3

MEEE 0045: INTRODUCTION TO HYBRID & ELECTRIC VEHICLES

Objective: *The objective of this is to introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Hybrid Electric Vehicles:** History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, mathematical models to describe vehicle performance. **Hybrid Electric Drive-trains:** Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies. **Electric Drive-trainsand Propulsion Units**: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles.	20
II	**Energy Storage**: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis. Sizing the drive system: Matching the electric machine and the Internal Combustion Engine (ICE), Sizing the propulsion motor, sizing the power electronics. **Energy Management Strategies:** Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management. Strategies and their comparison. **Case Studies:** Design of a Hybrid Electric Vehicle (HEV), modeling and simulation of Electric and Hybrid Vehicles.	20

Text Books:

- John G. Hayes, G. Abas Goodarzi, "Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles" John Wiley & sons Publishers Ltd 2018.

Reference Books:

- Ali Emadi, "Advanced Electric Drive Vehicles" Published by CRC Press April 21, 2017
- Mi.Chris, M. Abul Masrur, "Hybrid Electric Vehicles : Principles and Applications with Practical Perspectives" ,2nd Edition John Wiley & sons Publishers Ltd 2017.
- Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", Published by CRC Press March 28, 2018

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the need of EV and HEV for current scenario, role of different components used in EV /HEV and its drive train topology

CO2: Able to select the electric propulsion unit and its control for EV/HEV.

CO3 Modeling and Analysis the energy storage for EV and HEV applications

CO4 Design the control strategies for of Energy Management in EV/HEV

CO5 Able to analyze, simulate and evaluate the performance of hybrid electric vehicle

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO3
CO5	PO1, PO2, PO3, PO4, PSO2, PSO3

MEEE 0022: ELECTRICAL INSULATION IN POWER APPARATUS & SYSTEMS

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Introduction: Role of the insulation in power apparatus and systems, essential properties of dielectrics, Insulating materials commonly used in power system equipment: review, electric fields, breakdown mechanisms in gases, Breakdown mechanisms in liquids, breakdown mechanisms in vacuum, breakdown mechanisms in solids, partial discharge.	14
II	Basic electrical design concepts, principles of insulation coordination, ageing mechanisms, insulation defects in power system equipment, insulation testing basics, testing of power apparatus.	13
III	Generation of high voltages, measurement of high voltages, condition monitoring of power apparatus, new advanced techniques in diagnosis and monitoring.	13

References:

- Advances in high voltage engineering, edited by A. Haddad and D. Warne, IEE Power and Energy Series, 2004.
- Electrical Insulation in Power Systems, N.H.Malik, A. A. Al-Arainy and M. I. Qureshi, Marcel Dekker, 1997.
- Insulation of High Voltage Equipment, V.Y. Ushakov, Springer-Verlag, 2004.
- High Voltage Engineering Fundamentals, KuffelZaengelKuffel, Newnes.

Additional Readings:

- IEEE Transactions on Dielectrics and Electrical Insulation: select papers.
- Insulation Magazine (IEEE): select papers.

Course outcomes

After completion of this course the students will be able to :

1. *Understand the role of insulation in power apparatus, the breakdown mechanism*
2. *Demonstrate the new advanced techniques in diagnosis and monitoring*
3. *Analyze the performance of electrical insulation design*
4. *Distinguish the different high voltages generation and measurement by various techniques*

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO3

MEEC0800: ADVANCED SIMULATION LAB

Objective: *Primary purpose of this laboratory course is to familiarize students with the simulation environment by using MATLAB & PSIM simulation software. Along with introduction, the software can be used in verification and analysis of various electrical theorems and theoretical problems with great ease.*

Credits:01 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I,II,III	1. To solve set of linear algebraic equation using left operation vector. Hence extend the concept for the underdetermined & over determined systems by " rrev" & "pinv" commands. 2. To study various relational & logical operator and hence write a script file to plot the function $y= 15\sqrt{4x}+10 \quad x\geq 9$ $= 10x+10 \quad 0\leq x<9$ $=10 \quad x<0$ for $-5\leq x\leq 30$ 3. To study various plotting commands like axis, fplot,grid,plot,title,xlabel,ylabel and hence plot the polynomial of the form $ax^5+bx^4+cx^3+dx^2+ex+f$ over the range $-x_1\leq x\leq x_2$ with a spacing of 0.01. 4. To understand various commands for 3D plots like contour , mesh,surf,meshgrid and hence create a surface plot & contour plot of the function $z=(x-2)^2+2xy+y^2.4$ 5. To simulate half controlled converter with R and RL load using MATLAB/SIMULINK/PSIM 6. To simulate fully controlled converter with R and RL load using MATLAB/SIMULINK/PSIM 7. To perform load flow analysis using ETAP software for a given power system. 8. To perform fault analysis for a given power system using ETAP software. 9. To perform the Economic load dispatch using MATLAB/ETAP 10. To design a Buck/Boost converter for solar PV system using PSIM	24

References:

- William J Palm, " *Introduction to MATLAB for engineers", Mcgraw Hill.*
- PSIM User guide, version 9.3 , release 4, May 2014

Focus: This course focuses on Employability aligned with all COs.

Outcome: *After completion of course, the student will be able to:*

1. *Demonstrate the application of MATLAB/SIMULINK/ PSIM/ETAP*
2. *Simulate the power electronic converters for different loading conditions and economic dispatch problem using MATLAB/SIMULINK/PSIM/ETAP.*

Mapping of Course Outcomes (COs) withProgram Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs

CO1	PO1,PO2, PO3, PO4, PO5/PSO2, PSO3
CO2	PO1,PO2, PO3, PO4, PO5, PO9 /PSO2, PSO3

MEEC 0007: ADVANCED POWER SYSTEM OPERATION & CONTROL

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Characteristics of Modern Power Systems, physical structure, operation and control functions and hierarchies, design and operating Criteria of power system (quality, reliability, security stability & economy). **Security Analysis:** various operating states & major components of security assessments (system monitoring, contingency analysis, preventive and corrective actions). **Economic operation:** Input-output characteristics of thermal and hydro-plants, system constraints, optimal operation of thermal units without and with **Equipment and Stability Constraints:** Capabilities and constraints of Generators/Exciters/Turbines/Network Elements (Lines, Transformers etc.), constraints of energy supply systems, load characteristics, introduction to angle/voltage instability phenomena, stability Constraints	21
II	**Load frequency control:** Concept of load frequency control, load frequency control of single area system, turbine speed governing system and modeling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, load frequency control and economic dispatch control. **Load frequency control of two area system**: Tie line power modeling, block diagram representation of two area system, static and dynamic response. **Voltage & Reactive power control:** Concept of voltage control, methods of voltage control by tap changing transformer, shunt compensation (SVC), series compensation, and phase angle compensation, automatic voltage regulators (generators), introduction to the use of optimization methods.	21

Text Books:

1. D.P. Kothari & I.J. Nagrath, "Modern Power System Analysis" Tata Mc Graw Hill, 3rd Edition.
2. O.I. Elgerd, "Electric Energy System Theory" Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003.
3. P. Kundur, "Power System Stability and Control" Mc Graw Hill Publishers, USA.
4. P.S.R. Murty, "Operation and control in Power Systems" B.S. Publications.

References:

1. N. G. Hingorani & L. Gyugyi, "Understanding FACTS Concepts: and Technology of Flexible ac transmission systems" IEEE press.

2. A. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control "John Wiley & Sons.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *Upon completion of this course, students will be able to*
CO1: Understand the modeling and control of single area and two area power system including the concept of AGC.
CO2: Calculate various factors including maximum demand, load factor, demand factor, diversity factor etc.
CO3: Apply the concept of AGC, AVC and FACT controllers in power system operation.
CO4: Analyze the performance of economic operation of interconnected thermal-thermal and hydro-thermal power systems.

Mapping of Course Outcomes (CO) With Program Outcomes (PO) and Program Specific Outcomes (PSO):

Cos	**Pos/ PSOs**
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO2
CO3	PO2, PO4, PO5, PSO3
CO4	PO2, PO3,PO4, PSO3

MEEE 0021: POWER QUALITY & CONDITIONING

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Hours
I	**Review of Power Quality** Power quality standards, Long & short duration voltage variations, Sag, Swell, voltage imbalance; Notching D C offset, waveform distortion, power frequency variations, electrical transients **Harmonics** Causes of harmonics; current and voltage harmonics: measurement of harmonics; effects of harmonics on – transformers, AC motors, capacitor banks, cables, and protection Device, harmonic mitigation techniques. **Filters:** Passive and active filters for harmonic and reactive power compensation in two wire, three wire and four wire AC systems, harmonics standard, Harmonic filter design, surge suppressors, compensation of arc furnaces and traction loads.	21
II	**Monitoring power quality:** Monitoring essentials, power quality measuring equipment, Current industry trends, Fourier series, Fourier transform and wavelet transform. **Power Supply and Applications:** Analysis, design and control of SMPS, UPS on line and off line, Power supplies in telecommunication. High frequency induction heating, dielectric heating, microwave heating, electronic ballast, high power factor electronic ballast and applications. **Multilevel Converters and control:** modeling and analysis of advance static VAR compensation, multi level inverters, harmonic elimination method, ASVC structure, power converter control using state space average model	21

Text Books:

1. Roger C Dugan, McGrahan, Santoso&Beaty, "Electrical Power System Quality" McGraw Hill
2. ArinthomGhosh& Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic publishers
3. C. Sankaran, " Power Quality" CRC Press.
4. Alexander Kusko, Marc T.Thompson,"Power quality in electrical systems", Mcgraw Hill
5. Rashid M.H., Power Electronics Handbook, Elsevier Press (Academic Press series)
6. BollenM.H.J.,Understanding Power Quality and Voltage Sag, IEEE Press.

Focus: This course focuses on Employability aligned with all COs.

Course outcomes:

After the completion of the course, the students will be able to :
1. Understand and identify the sources of various power quality problems.
2. Calculate the impact of various power quality problems on appliances.
3. Analyze about causes of harmonic, its distortion effect and harmful effects of poor power quality and harmonics

4. Design the compensators and filters to keep the power quality indices within the standards.
5. Modeling and analysis of Multilevel Converters

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4, PSO1, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1,PSO2,PSO3
CO5	PO1, PO2, PO3, PO4, PSO1, PSO3
CO6	PO1, PO2, PO3, PO4, PSO2, PSO3

MEEE0029: POWER SYSTEM PLANNING & RELIABILITY

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Load Forecasting –**Introduction, classification of load, load growth characteristics, peak load forecasting, extrapolation & co-relation methods of load forecasting, energy forecasting, reactive load forecasting, annual, monthly & total forecasting **System planning-** Objectives & factors affecting system planning , short, medium & long term planning, reactive power planning **Generation & transmission planning-** Objectives of generation planning, factors affecting generation planning, objectives of transmission planning network reconfiguration Power system Reliability – Concepts, terms & definitions , outage, failure rate, & outage rate availability, unavailability, reliability models, reliability function mean time to failure, hazard rate function	21
II	Reliability of systems – Series & parallel configuration, combined series & parallel systems, system structure faction, minimal cuts & minimal paths Generating Capacity-Basic probability methods , frequency & duration method, generation system model, capacity outage probability table, recursive algorithm, loss of load expectation, loss of energy Composite generation & transmission system- Data requirement, system & load point indices, impact of component outage on the system Reliability ,application to simple system	21

References:

1. Sullivan, R.L., 'Power System Planning', Heber Hill, 1987
2. Roy Billington, 'Power System Reliability Evaluation', Gordan& Breach Scain Publishers, 1990.
3. Eodrenyi, J., 'Reliability modelling in Electric Power System' John Wiley, 1980.X.Wang &J.R.Mcdonald, " Modern Power System Planning", Mc-graw Hill

Focus: This course focuses on Employability aligned with all COs.

Course outcomes:

1. *Understand the classification of load and load growth*
2. *Analyze the factors affecting system planning*
3. *Understand Concepts, terms & definitions of power system reliability.*
4. *Calculate the reliability models and reliability function*
5. *Understand basic probability methods, frequency and duration methods etc.*
6. *Understand system and load point indices.*

	COs	**POs/ PSOs**
	CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
	CO2	PO1, PO2, PO3, PO4, PSO2
	CO3	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
	CO4	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
	CO5	PO1, PO2, PO3, PO4, PSO2, PSO3
	CO6	PO1, PO2, PO3, PO4, PSO1, PSO3

MEEE0028-POWER SYSTEM RESTRUCTURING & DEREGULATION

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** motivations for restructuring the power industry, privatization & deregulation, fundamentals of economics, components of restructured system **Philosophy of market models:** market architecture ,restructuring models, comparison of various market models, Trading arrangements (Pool, bilateral & multilateral), open access transmission systems, four pillars of market design. congestion Management: features,ATC,TTC,TRM,CBM, ATC calculation using Power Transfer Distribution Factor(PTDF)and Line Outage Distribution Factor (LODF) based on DC model, Calculation of ATC using AC model ,nodal pricing, price area congestion management, OPF based congestion management (DC OPF & AC OPF)	21
II	**Locational Marginal Prices (LMP) and Financial Transmission Rights (FTR):** mathematical preliminaries, Fundamentals of locational marginal pricing, Lossless DCOPF model for LMP calculation, ACOPF model for LMP calculation , FTR auction, FTR allocation, Flow Gate rights **Ancillary Service Management** Introduction to ancillary services ,load-generation balancing related services ,voltage control and reactive power support services, comparison between different sources of reactive power ,Black start capability service **Pricing of transmission network usage and loss allocation** Classification of transmission pricing methods, rolled-in transmission pricing methods, marginal transmission pricing paradigm. Introduction to loss allocation, classification of loss allocation methods optimal bidding methods-Game theory, Markov decision process, Genetic algorithm etc. US and European market evolution Reforms in Indian power sector	21

Text Book:

1. Lai, L.L., Power System Restructuring and Deregulation: Trading Performance and Information Technology, John Wiley and Sons (2001).
2. Stoft, S., Power System Economics, IEEE Computer Society Press (2002).
3. K. Bhattacharya, MHT Bollen and J.C Doolder, "Operation of Restructured Power Systems", Kluwer Academic Publishers, USA, 2001
4. **Making competition work in electricity** Sally Hunt, John Wiley & Sons, Inc., 2002.

Focus: This course focuses on Employability aligned with all COs.

Course outcomes

After the completion of this course students will be able to:

1. *Understand the fundamentals concept of restructured system congestion management and ancillary service*
2. *Calculate the fundamentals of Location Marginal Prices (LMP) and Financial Transmission Rights (FTR)*
3. *Apply the philosophy of market models in small distribution systems*
4. *Analyze the concepts about pricing of transmission network usage and loss allocation.*

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO5	PO1, PO2, PO3, PO4, PSO1, PSO2
CO6	PO1, PO2, PO3, PO4, PS3

Course Curriculum (2020-21)

MEEE0027: EHV/UHV POWER TRANSMISSION ENGINEERING

Credits: 04 | **Semester III** | **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Electrical power transmission by HVAC/HVDC, Overhead transmission lines, Bundled conductors, Mechanical vibration of conductors, Surface voltage gradient on conductors, Corona and associated power loss. Radio-noise and Audio-noise & their measurement, Fields under transmission lines,	21
II	Overhead line insulators, Insulator performance in polluted environment. EHV cable transmission- underground cables and GIL, High voltage substations-AIS and GIS, Grounding of towers and substations, Over voltages in power systems, Insulation Co-ordination.	21

Text Books/References Books:

1. R. D. Begamudre, 'Extra High Voltage AC Transmission Engg.', Wiley Eastern Limited, 1990.
2. Transmission Line Reference Book 345KV and above, Electrical Power Research Institute(EPRI), 1982.
3. Power Engineer's Handbook, 6th Edition TNEB Engineers' Association, October 2002.

Focus: This course focuses on Employability aligned with all COs.

Course Outcome

After the completion of this course the students will be able to :

1. *Understand the basic concepts of power transmission, modeling, conductors, voltage gradient, transmission lines and overhead line insulators*
2. *Demonstrate the basic concepts about EHV cables, high voltage substations, insulation, coordination etc.*
3. *Analyze the concept of radio noise , audio noise measurements in EHV transmission line*
4. *Design the high voltage ac / dc transmission lines*

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3

MEEE 0047: RENEWABLE & DISTRIBUTED GENERATION SYSTEMS

Objective: *The objective of this course is to introduce the fundamental concepts, principles, analysis and design of solar and wind energy system and its integration with grid.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction**- Renewable Sources of Energy Grid-Supplied Electricity **Solar energy:** Solar PV cell, generation of electricity, PV cell characteristic, photovoltaic power plants **Fuel cells:** Fuel cells equivalent circuit, Aspects of Hydrogen as fuel. **Wind energy**- Aerodynamics model, rotor types, braking systems, control and monitoring system. **Wind driven induction generators**- operating principle, power circle diagram, steady state performance, modeling, wind farm electrical design.	21
II	**Hybrid Source** Wind-diesel systems, fuel savings, permanent magnet alternators, modeling, steady state equivalent circuit, self-excited induction generators, integrated wind- solar systems **Storage systems:** Parameters, lead-acid batteries, ultra-capacitors, flywheels, superconducting magnetic storage system, pumped hydroelectric energy storage, compressed air energy storage. **Distributed Generation**- Hybrid Co-generation: Solar PV, wind, SHP, DG and their combinations, Hybrid power systems with and without grid connected. Operating features and performance.	21

Text Books:

- M. Masters, 'Renewable and Efficient Electric Power Systems', John Wiley & Sons, Aug 2013

Reference Books:

- Godfrey Boyle, 'Renewable Energy-power for a sustainable future', 3rd ed. Oxford University press. Dec 2012
- Felix A. Farret, M. Godoy Simoes: Integration of Alternative Sources of Energy, John Wiley & Sons, 2005

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand PV power generation principles, its characteristics and Fuel cell equivalent circuit and its working

CO2: Model the wind energy conversion system and its aerodynamics model.

CO3: Model the generators used in WECS.

CO4: Model and Characterize the different energy storage systems.

CO5: Understand the concept of distributed generations

CO6: Analyze the performance of hybrid sources

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4,
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO5	PO1, PO2, PSO3
CO6	PO1, PO2, PO3, PO4, PSO2, PSO3

Course Curriculum (2020-21)

MEEE 0045: INTRODUCTION TO HYBRID & ELECTRIC VEHICLES

Objective: *The objective of this is to introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Hybrid Electric Vehicles:** History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, mathematical models to describe vehicle performance. **Hybrid Electric Drive-trains:** Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies. **Electric Drive-trainsand Propulsion Units**: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles.	20
II	**Energy Storage**: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis. Sizing the drive system: Matching the electric machine and the Internal Combustion Engine (ICE), Sizing the propulsion motor, sizing the power electronics. **Energy Management Strategies:** Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management. Strategies and their comparison. **Case Studies:** Design of a Hybrid Electric Vehicle (HEV), modeling and simulation of Electric and Hybrid Vehicles.	20

Text Books:

- John G. Hayes, G. Abas Goodarzi, "Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles" John Wiley & sons Publishers Ltd 2018.

Reference Books:

- Ali Emadi, "Advanced Electric Drive Vehicles" Published by CRC Press April 21, 2017
- Mi.Chris, M. Abul Masrur, "Hybrid Electric Vehicles : Principles and Applications with Practical Perspectives" ,2nd Edition John Wiley & sons Publishers Ltd 2017.
- Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", Published by CRC Press March 28, 2018

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand the need of EV and HEV for current scenario, role of different components used in EV /HEV and its drivetrain topology
CO2: Able to select the electric propulsion unit and its control for EV/HEV.
CO3 Modelling and Analysis the energy storage for EV and HEV applications
CO4 Design the control strategies for of Energy Management in EV/HEV
CO5 Able to analyze, simulate and evaluate the performance of hybrid electric vehicle

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO3
CO5	PO1, PO2, PO3, PO4, PSO2, PSO3

MEEE0026- SMART GRID & PHASOR MEASURMENT TECHNIQUES

Objective: *To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure. To get familiarized with the power quality management issues in Smart Grid.*

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Smart Grid** Evolution of electric grid, concept of smart Grid, definitions, need of smart grid, functions of smart grid, difference between conventional & smart grid, concept of resilient &self-healing grid, present development & International policies on smart grid. **Smart Grid Technologies:** Introduction to smart meters & hardware used, automatic meter reading(AMR), outage management system(OMS),substation automation equipments, smart sensors, home & building automation,smart storage like battery, SMES, pumped hydro, compressed air energy storage, phase measurement unit(PMU). **Phasor measurement techniques** Phasor representation of sinusoids, phasor measurement units & phasor data concentrators, evolution of synchrophasor, hierarchy for phasor measurement system.	21
II	**Performance analysis tools for Smart grid design** Introduction to load flow studies, challenges to load flow in smart grid, limitations of classical load flow methods, load flow for smart grid design, congestion management effect. **Stability analysis tools for Smart grid** Introduction to stability, strength & weaknesses of existing voltage stability analysis tools, voltage stability assessment, analysis techniques for dynamic voltage stability studies, voltage stability indexing, angle stability assessment. Introduction to smart grid pathway design, barriers and solutions to smart grid development, sustainable energy options for smart grids.	19

Text Books:

- James Momoh, “Smart Grid-Fundamental of design & analysis”,John Wiley, IEEE Press, 2012.
- Clark W. Gellings, “The Smart Grid:Enabling Energy Efficiency and Demand Response”,CRC Press, 2009.

Reference Books:

- Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley, 2012.
- Jean Claude Sabonnadière, Nouredine Hadjsaïd, “Smart Grids”, Wiley ISTE, 2012.
- Peter S. Fox Penner, “Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities”, Island Press; 1 edition 8 Jun 2010

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *At the end of the course, students will be able to –*

4. *Understand the smart technologies, smart meters, phasor measurement and stability analysis tools for smart grids.*
5. *Apply load flow in smart grid environment and assess the performance of smart grid.*
6. *Analyze the stability of smart grid using stability analysis tools.*
7. *Design the sustainable energy options for smart grid.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PO3, PSO2
CO3	PO2, PO3, PSO3
CO4	PO2, PO3, PO5, PSO3

MEEE 0024- POWER SYSTEM TRANSIENTS

Objective: *To make the students familiar with the theoretical basis for various forms of over voltages such as lighting strokes, surges, switching transients etc., and to introduce some of the protection measures against such over voltages are described. Also, to depict the necessity and methods for generating impulse voltages and currents.*

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Simple switching transients:** Transient response of RC, RL and RLC circuit, circuit closing transient, recoverytransient initiated by the removal of a short circuit, double frequencytransients. **Modeling of transmission lines/cables for transient studies** Travelling waves on transmission lines, wave equation, specification oftravelling waves, reflection and refraction of waves, equivalent circuit fortravelling wave studies, reactive termination, successive reflections, LatticeDiagrams, attenuation and distortion, self and mutual surge impedance. **Switching transients & over-voltages-**interruption of small inductivecurrents & capacitive current, transformer inrush current, overvoltage due toresonance, overvoltage due to load rejection, ferroresonance	18
II	**Lightning induced transients-** mechanism of lightning, wave-shape of thelightning current, direct lightning stroke, shielding, transients in groundingSystems Power system transient recovery voltages, electromagnetic phenomenon undertransient conditions, electrostatic & electromagnetic induction with transientapplications, electromagnetic shielding. **Transient behavior electrical devices-** synchronous generator three phaseterminal fault, transient reactances of synchronous generators, saturation &timeconstant.Transient behavior of induction & synchronous motors, transientbehavior oftransformers **Insulation Co-ordination** Principle of insulation co-ordination in Air Insulated substation (AIS) and GasInsulated Substation (GIS), insulation level, statistical approach, co-ordinationbetween insulation and protection level, overvoltage protective devices,lightning arresters.	22

Text Books:

- Reinhold Ruder Berg, R.R., 'Transient Performanceof Electric Power systems', MIT Press, 1991.
- Pritindra Chowdhari, Electromagnetic transients in Power System, John Wiley and Sons Inc., Second Edition, 2009.

Reference Books:

- Allen Greenwood, 'Electrical transients in power systems', Wiley Interscience, New york, 2nd edition 1991.
- Arieh L. Shenkman,'Transient Analysis of Electric Power Circuits Handbook',Springer, 2005.
- Bewley, L.W., 'Travelling waves and transmission systems', Dover publications, New York, 1963.
- Akihiro ametani, Power System Transient theory and applications, CRC press, 2013.

Focus: This course focuses on Employability aligned with all COs.
Outcomes: *At the end of the course, students will be able to –*

8. *Understand the switching transients, lightening induced transients, transient characteristics of the electrical devices, concept of insulation co-ordination and the concepts of modeling for the transmission lines/ cables etc.*
9. *Demonstrate the designprocedureof the power system protection schemesusing ground wires, surge absorbersand arrestors.*
10. *Evaluate system parameters for modelling the overhead lines and underground cable systems.*
11. *Analyze the power system behaviour during switching transientsand lightning surgesand the causes of the transients and how these can be reduced or eliminated.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO3
CO3	PO2, PO3, PSO3
CO4	PO2, PO3, PO4, PSO3

MEEC0004: POWER ELECTRONIC DEVICES & CONVERTERS

Credits: 04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Review of Power Electronic Converters:** Thyristor, GTO, MOSFET, BJT, IGBT and MCT; Drive circuit and switching network for power switching devices; Boost and buck converters using BJT and IGBT circuits; Thyristor and BJT based converter, phase control, effect on power factor, harmonics, inverter circuit using BJT and MOS devices; PWM technique for voltage and harmonic control	12
II	**Switched Mode Power Supply:**Basic rectifier concepts of DC-DC converters and closed loop control; Resonant DC-DC converters: operating principle, waveforms, switching trajectory and losses and control; PWM inverter modulation strategies: sine wave with third harmonic, space vector modulation and predictive current control techniques, PWM rectifier; Three level inverter: basic topology and waveform, improvement in harmonics and high voltage application; Resonant ac link / dc link inverters Cycloconverters: Circuit, operating principle, control, harmonics, power factor and applications; Non-drive application of power electronic converters: back to back HVDC transmission, induction heating, electronic ballast, UPS, SVC and active filters. Industrial PWM driver chips for power supplies such as UC 3843, 3825 or equivalent.	24

Text Books:

- N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics, Converter, Application and Design", Third Edition, John Willey & Sons, 2004.
- M. H. Rashid, "Power Electronics, circuits, Devices and Applications", Pearson, 2002, India.
- Power Electronics Devices, Circuits and Industrial applications, V.R. Moorthi, Oxford University Press.

Reference Books:

- Power Electronics, Dr. P. S. Bimbhra, Khanna Pubishers.
- Elements of Power Electronics, Philip T. Krein, Oxford University Press.
- Power Electronics, M. S. Jamil Asghar, PHI Private Limited.
- Principles of Power Electronics John G. Kassakian, Martin F. Schlect, Geroge C.

Focus: This course focuses on Employability aligned with all COs.
Course Outcome: *At the end of the course students should be able to:*

CO-1. Understand the working of various power electronic devices and PWM techniques for converters.
CO-2. Derive the mathematical relations, analyze, and design electronics for the control of converters.
CO-3. Gain the knowledge of harmonics control and power factor correction strategies and design of the multilevel inverter.
CO-4. To analyze the working of induction heating, UPS, power supplies and electronic ballasts.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, / PSO1
CO2	PO1, PO2,/ PSO1, PSO3
CO3	PO1, PO2, PO3,/PSO1, PSO3
CO4	PO1, PO2, PO3/ PSO1, PSO2, PSO3

MEEC1005: Optimization Techniques

Objective: *The purpose of this course is to develop a knowledge in the field of optimization techniques their basic concepts principles using linear, nonlinear, integer programming and metaheuristics approach.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Optimization:** Definition, classification of optimization problems, classical optimization techniques-single variable and multiple with and without constraints, Convex Programming Problem: feasibility and optimality conditions. **Linear Programming:** Geometry, Simplex method, Duality and Sensitivity, Interior Point methods, Transportation and Network Flow Problems. **Nonlinear Programming:** Single Variable- Elimination-Fibonacci and Golden search method, Interpolation methods-quadratic, cubic and direct root methods	22
II	**Nonlinear Programming:** Unconstrained n-dimensional Optimization-Introduction, Optimality conditions, Direct search methods-Random and Pattern Search methods and Indirect Search method- Steepest Descent. Newton's Method, Marquardt Method and Quasi Newton method, Constrained optimization-Introduction, Characteristics, Primal Methods, Penalty and Barrier Methods, Dual and Cutting Plane Methods **Integer Programming:** Integer Linear Programming-Graphical Representation, Cutting Plane method, Integer Nonlinear Programming-Branch-and-Bound Method, Sequential Linear Discrete Programming, Penalty Function method. **Meta Heuristic Techniques:** Simulated Annealing, Genetic Algorithm, Swarm based and other nature inspired optimization algorithms.	22

Text Books:

- David Luenberger and Yinyu Ye, Linear and Nonlinear Programming, 3rd Edition, Springer, 2008.
- Rao S. S., "Engineering Optimization: Theory and Practice", New Age International Pvt Ltd. 2019

References:

- Griva, Igor, Stephen G. Nash, and ArielaSofer. Linear and nonlinear optimization. Vol. 108. Siam, 2009.
- Mirjalili, Seyedali. "Evolutionary algorithms and neural networks." Studies in Computational Intelligence (2019).
- Goldberg, David E. Genetic algorithms. Pearson Education India, 2006.
- Eberhart, Russell, and James Kennedy. "A new optimizer using particle swarm theory." MHS'95. Proceedings of the Sixth International Symposium on Micro Machine and Human Science. IEEE, 1995.

Course Outcomes*: After completion of this course, student will be able to*

CO1. Identify different optimization problems.
CO2. Formulate mathematical models for single variable and multi-variable unconstrained and constrained optimization problems.
CO3. Apply the concept of optimality criteria for various optimization problems
CO4. Apply different optimization technique according to the problem for finding solutions of the optimization problems.
CO5. Solve the optimization problems using both traditional and non-traditional optimization techniques.
CO6. *Modify and develop the existing or new non-traditional optimization techniques.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2
CO5	PO1, PO2, PO3, PO4, PSO2, PSO3
CO6	PO1, PO2, PO3, PO4, PSO1, PSO3

MEEC 0008: MICROCONTROLLER AND APPLICATION

Objective: To develop the understanding, applications, interfacing the external devices with microprocessor and microcontroller.

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Review of 8-bit Microprocessor:** State transition diagram, interrupt structure, input/output techniques; Review of peripheral devices- Intel 8255 PPI and Intel 8253 PIT; ADC and DAC chips and their interfacing. **Programmable Interrupt Controller:** Intel 8259, pin configuration, functional description and operation in 8-bit and 16-bit environment, initialization and operation control words. **Keyboard and Display Interface:** Intel 8279, concept of display interface and keyboard interface, pin configuration of Intel 8279, functional description. **Intel 8051/8052 Microcontroller:** Introduction, architecture, functional diagram, pin description, CMOS and HMOS microcontrollers and their difference, oscillator, CPU Timing.	20
II	**Memory Organization:** Accessing external program and data memory, internal data memory, special function registers, hardware interfacing, timing diagrams, I/O expansion. **I/O Ports and Timer:** Internal structure of ports P0, P1, P2 and P3, alternative functions of port P3; Timer and counter operation, TM0, TM1 and TM2, modes of operation; Applications. **Programming:** Addressing modes; Instruction set: Data transfer group, arithmetic group, logical group, control group and Boolean processing capability; Programming and erasing EPROM. **Interrupts:** Types, interrupt priority and interrupt enable registers, processing of interrupt, single-step operation. **Serial Port:** Modes of operation, programming, multi-processor control.	20

Text Books:

- Mazidi M.A. and Mazidi J.G., “The 8051 Microcontroller and Embedded Systems”, 2nd Ed., Pearson Education. 2013.

Reference Books:

- Deshmukh A.V., “Microcontroller: Theory and Applications”, Tata McGraw-Hill Publishing Company Limited.
- Hall D.V., “Microprocessor and Interfacing –Programming and Hardware”, 2nd Ed., Tata McGraw-Hill Publishing Company Limited
- Ayala, Kenneth J, “The 8051 Microcontroller : Architecture, Programming, and Applications”,Penram International Publishing(India) Pvt. Ltd.

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1.Understand about the architecture 8 bit microprocessor

CO2.Understand the programmable interrupt controller such as intel 8259, intel 8279 etc.

CO3.Learn about excessing the external program and data memory.

CO4.Understand the programming of addressing modes, instruction sets etc.

CO5.Understand about the interrupts and their priorities.

CO6.Develop the Programme for multimode operations and multi-processor control.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO3
CO2	PO1, PO2, PO3, PO4, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2
CO5	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO6	PO1, PO2, PO3, PO4, PSO1, PSO3

MEEE 0021: POWER QUALITY & CONDITIONING

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Review of Power Quality** Power quality standards, Long & short duration voltage variations, Sag, Swell, voltage imbalance; Notching D C offset, waveform distortion, power frequency variations, electrical transients **Harmonics** Causes of harmonics; current and voltage harmonics: measurement of harmonics; effects of harmonics on – transformers, AC motors, capacitor banks, cables, and protection Device, harmonic mitigation techniques. **Filters:** Passive and active filters for harmonic and reactive power compensation in two wire, three wire and four wire AC systems, harmonics standard, Harmonic filter design, surge suppressors, compensation of arc furnaces and traction loads.	21
II	**Monitoring power quality**: Monitoring essentials, power quality measuring equipment, Current industry trends, Fourier series, Fourier transform and wavelet transform. **Power Supply and Applications:** Analysis, design and control of SMPS, UPS on line and off line, Power supplies in telecommunication. High frequency induction heating, dielectric heating, microwave heating, electronic ballast, high power factor electronic ballast and applications. **Multilevel Converters and control:** modeling and analysis of advance static VAR compensation, multi level inverters, harmonic elimination method, ASVC structure, power converter control using state space average model	21

Text Books:

7. Roger C Dugan, McGrahan, Santoso&Beaty, "Electrical Power System Quality" McGraw Hill
8. ArinthomGhosh& Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic publishers
9. C. Sankaran, " Power Quality" CRC Press.
10. Alexander Kusko, Marc T.Thompson,"Power quality in electrical systems", Mcgraw Hill
11. Rashid M.H., Power Electronics Handbook, Elsevier Press (Academic Press series)
12. BollenM.H.J.,Understanding Power Quality and Voltage Sag, IEEE Press.

Focus: This course focuses on Employability aligned with all COs.

Course outcomes:

After the completion of the course, the students will be able to :
1. Understand and identify the sources of various power quality problems.
2. Calculate the impact of various power quality problems on appliances.

3. Analyze about causes of harmonic, its distortion effect and harmful effects of poor power quality and harmonics
4. Design the compensators and filters to keep the power quality indices within the standards.
5. Modeling and analysis of Multilevel Converters

COs	**POs/ PSOs**
CO1	PO1, PO2, PO3, PO4, PSO1
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO2,
CO4	PO1, PO2, PO3, PO4, PSO1,PPSO3
CO5	PO1, PO2, PO3, PO4, PSO1, PSO3

MEEE 0046: HIGH PERFORMANCE AC DRIVES

Credits: 04 **L–T–P-J: 4–0–0-0**

Module	Content	Teaching Hour
I	**Induction Machine Drives:** Basic concept of AC drives, equivalent circuit, performance under motoring and braking operations, modeling of induction machine, vector control of induction machine drives, direct torque control and sensor less control of induction machine. **Synchronous Machine Drives:** Equivalent circuit, performance under motoring and braking operations, modeling of synchronous machine,	21
II	Operations with non-sinusoidal power supplies, self- controlled synchronous motor drives, switched and synchronous reluctance motor drives. **Multi-phase AC Drives:** Introduction, modeling of five-phase motor (induction and PM) , vector control offive-phase induction motor, five-phase PM motor drives, five-phase inverters,introduction to fuzzy logic and neural network applications in AC drives.	22

Text Books:

Mukhtar Ahmad, "High Performance AC Drives Modeling, Analysis and Control", Springer Verlag 2010.

- Haitham Abu-Rub, Atif Iqbal and Jaroslaw Guzinski , "High Performance Control of AC Drives with Matlab / Simulink Models", John Wiley &Sons.
-
- R Krishnan , "Electric Motor Drives, Modeling ,Analysis and Control", Prentice Hall of India2002.
-
- R Krishnan,"Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications", CRC Press2001.

Focus: This course focuses on Employability aligned with all COs.

Course outcomes: *After the completion of this course the students will be able to:*

1. *Understand the basic concepts of ac drives, modeling of induction machines and concepts of synchronous machine drives.*
2. *Learn about the concepts of vector control, torque control etc.*
3. *Analyze the equivalent circuit and performance evaluation of different drives.*
4. *Apply the basic concepts about fuzzy logic and neural network applications in AC Drives.*

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, / PSO1
CO2	PO1, PO2,/ PSO1, PSO3
CO3	PO1, PO2, PO3,/PSO1, PSO3
CO4	PO1, PO2, PO3/ PSO1, PSO2, PSO3

COURSE STRUCTURE

PH. D.

ELECTRICAL ENGINEERING

Under

Choice Based Credit System (CBCS)

Department Of Electrical Engineering

GLA University, Mathura (U.P.)

Program Electives

SR. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT HRS/WK
			L	T	P		
1.	MEEC0001	Computer Aided Power system analysis	4	0	0	4	4
2.	MEEC1002	Power system Dynamics	4	0	0	4	4
3.	MEEC0003	Advanced Electric Drives	4	0	0	4	4
4.	MEEC0004	Power Electronic Devices & Converters	4	0	0	4	4
5.	MEEC1005	Optimization Techniques	4	0	0	4	4
6.	MEEC0006	Analog & digital control system	4	0	0	4	4
7.	MEEC0007	Renewable & distributed generation systems	4	0	0	4	4
8.	MEEC0008	Microcontroller and Application	4	0	0	4	4
9.	PREC 0001/PMG 1001	Research Methodology	4	0	0	4	4
10.	PREC 0010	Research and publication ethics	4	0	0	4	4

MEN 3033/PEEE 0003: RENEWABLE & DISTRIBUTED GENERATION SYSTEMS

Objective: *The objective of this course is to introduce the fundamental concepts, principles, analysis and design of solar and wind energy system and its integration with grid.*

Credits: 04 **L-T-P-J: 4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction-** Renewable Sources of Energy Grid-Supplied Electricity **Solar energy:** Solar PV cell, generation of electricity, PV cell characteristic, photovoltaic power plants **Fuel cells:** Fuel cells equivalent circuit, Aspects of Hydrogen as fuel. **Wind energy-** Aerodynamics model, rotor types, braking systems, control and monitoring system. **Wind driven induction generators-** operating principle, power circle diagram, steady state performance, modeling, wind farm electrical design.	21
II	**Hybrid Source** Wind-diesel systems, fuel savings, permanent magnet alternators, modeling, steady state equivalent circuit, self-excited induction generators, integrated wind- solar systems **Storage systems:** Parameters, lead-acid batteries, ultra-capacitors, flywheels, superconducting magnetic storage system, pumped hydroelectric energy storage, compressed air energy storage. **Distributed Generation-** Hybrid Co-generation: Solar PV, wind, SHP, DG and their combinations, Hybrid power systems with and without grid connected. Operating features and performance.	21

Text Books:

- M. Masters, 'Renewable and Efficient Electric Power Systems', John Wiley & Sons, Aug 2013

Reference Books:

- Godfrey Boyle, 'Renewable Energy-power for a sustainable future', 3rd ed. Oxford University press. Dec 2012
- Felix A. Farret, M. Godoy Simoes: Integration of Alternative Sources of Energy, John Wiley & Sons, 2005

Focus: This course focuses on Employability aligned with all COs.

Outcome: After completion of course, the student will be able to:

CO1: Understand PV power generation principles, its characteristics and Fuel cell equivalent circuit and its working

CO2: Model the wind energy conversion system and its aerodynamics model.

CO3: Model the generators used in WECS.

CO4: Model and Characterize the different energy storage systems.

CO5: Understand the concept of distributed generations

CO6: Analyze the performance of hybrid sources

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO3
CO3	PO1, PO2, PO3, PO4,
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO5	PO1, PO2, PSO3
CO6	PO1, PO2, PO3, PO4, PSO2, PSO3

MEN 1004/PEEE 0006: POWER ELECTRONIC DEVICES & CONVERTERS

Credits: 04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Review of Power Electronic Converters:** Thyristor, GTO, MOSFET, BJT, IGBT and MCT; Drive circuit and switching network for power switching devices; Boost and buck converters using BJT and IGBT circuits; Thyristor and BJT based converter, phase control, effect on power factor, harmonics, inverter circuit using BJT and MOS devices; PWM technique for voltage and harmonic control **Switched Mode Power Supply:** Basic rectifier concepts of DC-DC converters and closed loop control; Resonant DC-DC converters: operating principle, waveforms, switching trajectory and losses and control;	20
II	**Switched Mode Power Supply:** PWM inverter modulation strategies: sine wave with third harmonic, space vector modulation and predictive current control techniques, PWM rectifier; Three level inverter: basic topology and waveform, improvement in harmonics and high voltage application; Resonant ac link / dc link inverters Cycloconverters: Circuit, operating principle, control, harmonics, power factor and applications; Non-drive application of power electronic converters: back to back HVDC transmission, induction heating, electronic ballast, UPS, SVC and active filters. Industrial PWM driver chips for power supplies such as UC 3843, 3825 or equivalent.	22

Text Books:

- N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics, Converter, Application and Design", Third Edition, John Willey & Sons, 2004.
- M. H. Rashid, "Power Electronics, circuits, Devices and Applications", Pearson, 2002, India.
- Power Electronics Devices, Circuits and Industrial applications, V.R. Moorthi, Oxford University Press.

Reference Books:

- Power Electronics, Dr. P. S. Bimbhra, Khanna Pubishers.
- Elements of Power Electronics, Philip T. Krein, Oxford University Press.
- Power Electronics, M. S. Jamil Asghar, PHI Private Limited.
- Principles of Power Electronics John G. Kassakian, Martin F. Schlect, Geroge C.

Focus: This course focuses on Employability aligned with all COs.
Course Outcome: *At the end of the course students should be able to:*

CO-1. Understand the working of various power electronic devices and PWM techniques for converters.
CO-2. Derive the mathematical relations, analyze, and design electronics for the control of converters.
CO-3. Gain the knowledge of harmonics control and power factor correction strategies and design of the multilevel inverter.
CO-4. To analyze the working of induction heating, UPS, power supplies and electronic ballasts.

Mapping of Course Outcomes (CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1, PO2, / PSO1
CO2	PO1, PO2,/ PSO1, PSO3

CO3	PO1, PO2, PO3,/PSO1, PSO3
CO4	PO1, PO2, PO3/ PSO1, PSO2, PSO3

MEN 1005: Optimization Techniques

Objective: *The purpose of this course is to develop a knowledge in the field of optimization techniques their basic concepts principles using linear, nonlinear, integer programming and meta heuristics approach.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Optimization:** Definition, classification of optimization problems, classical optimization techniques-single variable and multiple with and without constraints, Convex Programming Problem: feasibility and optimality conditions. **Linear Programming:** Geometry, Simplex method, Duality and Sensitivity, Interior Point methods, Transportation and Network Flow Problems. **Nonlinear Programming:** Single Variable- Elimination-Fibonacci and Golden search method, Interpolation methods-quadratic, cubic and direct root methods	22
II	**Nonlinear Programming:** Unconstrained n-dimensional Optimization-Introduction, Optimality conditions, Direct search methods-Random and Pattern Search methods and Indirect Search method- Steepest Descent. Newton's Method, Marquardt Method and Quasi Newton method, Constrained optimization-Introduction, Characteristics, Primal Methods, Penalty and Barrier Methods, Dual and Cutting Plane Methods **Integer Programming:** Integer Linear Programming-Graphical Representation, Cutting Plane method, Integer Nonlinear Programming-Branch-and-Bound Method, Sequential Linear Discrete Programming, Penalty Function method. **Meta Heuristic Techniques:** Simulated Annealing, Genetic Algorithm, Swarm based and other nature inspired optimization algorithms.	22

Text Books:

- David Luenberger and Yinyu Ye, Linear and Nonlinear Programming, 3rd Edition, Springer, 2008.
- Rao S. S., "Engineering Optimization: Theory and Practice", New Age International Pvt Ltd. 2019

References:

- Griva, Igor, Stephen G. Nash, and ArielaSofer. Linear and nonlinear optimization. Vol. 108. Siam, 2009.
- Mirjalili, Seyedali. "Evolutionary algorithms and neural networks." Studies in Computational Intelligence (2019).
- Goldberg, David E. Genetic algorithms. Pearson Education India, 2006.
- Eberhart, Russell, and James Kennedy. "A new optimizer using particle swarm theory." MHS'95. Proceedings of the Sixth International Symposium on Micro Machine and Human Science. IEEE, 1995.

***Course Outcomes**: After completion of this course, student will be able to*

CO1. Identify different optimization problems.
CO2. Formulate mathematical models for single variable and multi-variable unconstrained and constrained optimization problems.
CO3. Apply the concept of optimality criteria for various optimization problems

CO4. Apply different optimization technique according to the problem for finding solutions of the optimization problems.
CO5. Solve the optimization problems using both traditional and non-traditional optimization techniques.
CO6. *Modify and develop the existing or new non-traditional optimization techniques.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4, PSO1, PSO3
CO4	PO1, PO2, PO3, PO4, PSO1, PSO2
CO5	PO1, PO2, PO3, PO4, PSO2, PSO3
CO6	PO1, PO2, PO3, PO4, PSO1, PSO3

MEN1007: ADVANCED ELECTRIC DRIVES

Credits: 04 **L–T–P: 4–0–0**

Module	Content	Teaching Hours
I	**Introduction:** Basic drive components, advantages of electric drives,selection of electric drives for industrial applications. **Stability of Motor-Load Systems:** Review of speed-torque characteristics of electric motors, types of mechanical loads and their characteristics, determination of stability of motor-load systems,load equalization. **Estimation of Motor Power Rating:** Heating and cooling of electric motors, thermal loading of electric motors, estimation of rating of electric motors for continuous, short time and intermittent duty loads	21
II	**Energy conservation in Electric Drive:** Losses in electric drive system and their minimization, efficient operation of electric drives. **Electric Braking:** Advantages of electric braking, requirements of a good braking system, Methods of electric braking of electric motors: Plugging, dynamic and regenerative braking of dc and ac motors. **Traction Drive:** Electric traction services, speed-time curves of electric traction motors, train resistance, tractive effort, specific energy consumption, calculations of power rating of traction motor,control of traction motors.	21

Text Book:

- G.K. Dubey, "Fundamentals of Electric Drive" Narosa Publishing House .
- G.K.Dubey," Power Semiconductor Controlled Drives", Prentice Hall.
- S.K. Pillai, "A first course on Electric Drive", New Age International Publishers.

References:

- N.K. DE and P.K. Sen, "Electric Drives," Prentice Hall of India.
- Vedam Subramanyam, "Electric Drive: Concepts and Applications" Tata McGraw Hill.
- M. Chilkin, "Electric Drive", Mir Publications.

Focus: This course focuses on Employability aligned with all COs.

Outcome: *On successful completion of the program, the student will be able to:*

1. *Understand the modeling* Basic drive *components, advantages of electric drives.*
2. *Evaluate speed-torque characteristics of electric motors, types of mechanical loads and their characteristics.*
3. *Analyze the Heating and cooling of electric motors, thermal loading of electric motors.*
4. *Compare various methods of electric braking of electric motors.*
5. *Analyze speed-time curves of electric traction motors, train resistance, tractive effort, specific energy consume.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1

CO2	PO1, PO2, PSO1
CO3	PO1, PO2, PO3, PSO3
CO4	PO1, PO2, PO3, PSO3
CO5	PO2, PO3, PO4, PSO3

PEEE 0001: POWER SYSTEM DYNAMICS

Objective: *The course aims to give basic knowledge about the power system dynamics and introduce & explain different stability issues in electric power system, including physical phenomenon, modeling issues and the stability improvement methods.*

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Power System Stability:** Basic concept of power system stability, classification; Rotor angle, frequency, and voltage stability, mid-term and long-termstability and their impacts; Analysis of Dynamical Systems. **Modeling of power system components for stability analysis:** Modeling of Synchronous Machines, Modeling of Excitation and Prime Mover Systems, Transmission Lines and Loads.	18
II	**Stability Issues in Interconnected Power Systems:** Analysis of single-machine and multi-machine systems, Transient stability analysis; Small signal stability analysis; Introduction to sub synchronous resonance; Voltage stability analysis. **Enhancement of Power System Stability:** Planning Measures; Stabilizing Controllers (Power System Stabilizers and FACTS controllers); Operational Measures- Preventive Control, Emergency Control.	22

Text Books:

- L.P.Singh , "Power System Analysis & Dynamics", Wiley Eastern, Delhi.
- P. Saur & M.A. Pai, "Power System Dynamics & Stability", Prentice Hall.
- P.Kundur, "Power System Stability and Control", Mc-Graw Hill.

Reference Books:

- A.A. Foud& P.M. Anderson, "Power System Stability and Control," Vol. F. Latest Indian Edition, Galgotia Press, New Delhi.
- K.R.Padiyar, "Power System Dynamics Stability & Control", Interline Publishers, Bangalore.
- E.W.Kimbark,"Power System Stability",Wiley-IEEE Press.

C.P.Taylor, "Power System Voltage Stability", Mc-Graw Hill.

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *At the end of the course, students will be able to –*

1. *Gather high-quality knowledge on stability, operation and control of power systems.*
2. *Analyze and understand the electromagnetic and electromechanical phenomenon taking place around the synchronous generator.*
3. *Identify and solve the stability related problems in power system.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1

CO2	PO1, PO2,
CO3	PO1, PO2, PO3, PSO3

PEEE 0003: ADVANCED POWER ELECTRONICS

Credits 04 L-T-P-J:4-0-0-0

Module No.	Content	Teaching hours
I	**PWM Inverters**: voltage control of 1-phase inverters (single-pulse-width modulation, multiple-pulse-width modulation, modified pulse-width modulation and phase displacement control), voltage control of 3-phase inverters, advance modulation techniques (trapezoidal, staircase, stepped, harmonic injected and delta modulation) and harmonic reductions. **Resonant Converters**: Advantages of resonant converters over PWM converters , principles of zero voltage and zero current switching, Classification – series and parallel resonant converters , load resonant converter half-bridge operation	21
II	**Resonant Converters**: discontinuous and continuous current modes , operation of zero current switching (ZCS) and zero voltage switching (ZVS) converters . **Resonant Pulse Inverters**: Introduction, series resonant inverters, series resonant inverters with unidirectional switches, series resonant inverters with bidirectional switches, frequency response of series-loaded, frequency response of parallel-loaded, frequency response of series – parallel-loaded, parallel resonant inverters, Class E resonant inverters, resonant dc-link inverters. Power Quality Mitigation Devices: Passive filters, active filters and hybrid filters.	21

Text Books:

- N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics, Converter, Application and Design",
  Third Edition, John Willey & Sons, 2004.
- M. H. Rashid, "Power Electronics, circuits, Devices and Applications", Pearson, 2002, India.
- Power Electronics Devices, Circuits and Industrial applications, V.R. Moorthi, Oxford University Press.

Reference Books:

- Power Electronics, Dr. P. S. Bimbhra, KhannaPubishers.
- Elements of Power Electronics, Philip T. Krein, Oxford University Press.
- Power Electronics, M. S. JamilAsghar, PHI Private Limited.
- Principles of Power Electronics John G. Kassakian, Martin F. Schlect, Geroge C. Verghese, Pearson Education.

Focus: This course focuses on Employability aligned with all COs.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2,
CO3	PO1, PO2, PO3, PSO3

PEEE0005: COMPUTER AIDED POWER SYSTEM ANALYSIS

Objective: *To perform steady state analysis and fault studies for a power system and to explore the nuances of estimation of different states of power system.*

Credits:04 **L-T-P-J:4-0-0-0**

Module No.	Contents	Teaching Hrs.
I	**AC Power Flow analysis:** Introduction, modeling of power system components, Formation of Y-Bus and Z-Bus matrices. Power flow equations. Solution algorithm; Gauss- Seidel, Newton-Raphson, Decoupled and Fast Decoupled Load Flow. DC Load Flow. Comparison of methods. **Sparse Matrices:** Optimal ordering schemes. LU factorization and solution algorithms. **Fault Analysis:** Modeling of large interconnected power system for fault analysis in phase coordinates and symmetrical components. Generalized expressions for fault current and bus voltages during fault. Types of fault and formation of three-phase Z_F& Y_F. Analysis of various faults.	24
II	**Contingency Analysis:** Introductiontocontingencyanalysisanditsnecessity.Operatingstatesof power system. Types of contingencies; network outage, power outage. Analysis of single and multiple contingencies. **State Estimation (SE) in Power Systems:** Introduction to SE in power system. The method of Weighted Least Squares, Statistics, Errors and Estimates, Test for bad data, Power System State Estimation. The structure and formation of Hessian. **Three Phase Load Flow:** Introduction to Three Phase Load Flow Analysis in Power System, Formation of three-phase Y-Bus. System modeling and power flow equations in three-phase. Solution Techniques. **Load Flow for Distribution System:** Introduction to radial and weakly meshed Distribution System, Load Flow using Forward/Backward sweep.	24

Text Book:

- G.W. Stagg & A.H. El-Abiad,'Computer Methods in Power System Analysis', Mc-Graw Hill, 1988.
- John J. Grainger and William D. Stevenson Jr., 'Power System Analysis', Mc-Graw Hill, 2011.
- Haadi Saadat, 'Power System Analysis', Mc-Graw Hill, 2010.

References:

- M A Pai and Dheeman Chatterjee, 'Computer Techniques in Power System Analysis', Mc-Graw Hill, 2017.
- A.R. Bergen and Vijay Vittal, 'Power Systems Analysis',Pearson Education Asia, 2001.
- J.D. Glover, M. Sharma and T.J. Overbye, 'Power SystemAnalysis and Design', Fourth Edition, ThomsonEngineering Press, 2008.
- William H. Kersting, 'Distribution System Modeling and Analysis', CRC Press, Taylor & Francis Group, 2018.

Focus: This course focuses on Employability aligned with all COs.

Outcome:*On successful completion of the program, the student will be able to:*

1. *Understand the modeling issues and analysis methods for the power flow, fault analysis, contingencyanalysis, required to be carried out for the power systems.*
2. *Understand the three-phase load flow and distribution system load flow.*
3. *Analyze the behavior of system during short circuit and the importance of contingency analysis.*
4. *Evaluate the effect of outage of any important component of power system on the operation and reliability of power systems.*
5. *Critically compare the solution methods used in power system studies.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO1
CO3	PO1, PO2, PO3, PSO3
CO4	PO1, PO2, PO3, PSO3
CO5	PO2, PO3, PO4, PSO3

MEN-2001: ANALOG AND DIGITAL CONTROL

Credits: 04 **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Continuous-Time State-Space Analysis:** State-space representation and state-diagram, Decomposition of transfer functions, Similarity transformation, Decoupling, Controllability and Observability. **State feedback systems:** Eigenvalue assignment by state feedback, fullorder and reduced order observers. The separation principle for output based pole placement. Applications.	13
II	**z- Transform analysis**: Pulse transfer-function, signal flow graph of discrete-time systems, Discretization of analog compensators, Stability analysis, Systems with dead-time. **Transform design of Digital Controllers**: Design specifications, direct and indirect design methods, design in w-plane, digital PID controller.	13
III	**Discrete-Time State-Space Analysis**: State equations, similarity transformations, realization of pulse-transfer functions, concepts of controllability and observability, Lyapunov stability analysis, systems with dead–time. **Controller Design Using State-Space Concepts**: Structure of state-feedback, formulation of optimal control problems, Eigen values assignment by state feedback, state observers.	14

Text Book:

- M. Gopal , "*Digital Control and State Variable Methods*", Tata McGraw-Hill Education.
- Katsuhiko Ogata, *"Discrete-time control systems"*, Prentice-Hall.

Reference Books:

- P.N. Paraskevopoulos, *"Digital Control Systems"*, Prentice Hall.
- Benjamin C. Kuo, "*Stable Adaptive Systems*", Prentice-Hall.

Focus: This course focuses on Employability aligned with all COs.

Outcome: *On successful completion of the program, the student will be able to:*

1. *Understand the modeling issues and analysis methods for* State-space representation
2. *Understand the* assignment by state feedback, full order and reduced order observers.
3. *Analyze pu*lse transfer-function, signal flow graph of discrete-time systems
4. *Evaluate* Design specifications, direct and indirect design methods, design in w-plane, digital PID controller.
5. *Critically compare* Controller Design Using State-Space Concepts.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PSO1
CO2	PO1, PO2, PSO1

CO3	PO1, PO2, PO3, PSO3
CO4	PO1, PO2, PO3, PSO3
CO5	PO2, PO3, PO4, PSO3

Open Elective (Offer to other Departments)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEO0090	Electrical Machine & Automatic Control	3	0	0	0	3	3	
2.	BEEO0092	Non-Conventional Energy Resources	4	0	0	0	4	4	
PRACTICALS									
3.	BEEO0900	Electrical Machines & Automatic Control Lab	0	0	2	0	1	2	BEEO0090

BEEO 0090: ELECTRICAL MACHINES AND AUTOMATIC CONTROL

Credits: 03 **L–T–P: 3–0–0**

Module	Contents	Teaching Hours
I	**Three -Phase Transformer**: Three-Phase Transformer connections and its applications. **DC Motors:** Torque equation, starting of DC motors, speed control. **Three-Phase Induction Motor:** Torque equation, torque-slip characteristics, speed control: v/f control, rotor resistance control. **Synchronous Machines**: Construction, derivation of EMF equation, parallel operation of alternators, effects of excitation on synchronous motor. Stepper motor, permanent magnet DC motor and its applications. **Analogous System:** Linear mechanical elements, force-voltage and force-current analogy, electrical analogy of simple mechanical systems. **Control System: Introduction:** Concept of transfer function and its determination for simple systems, open loop and closed loop controls, servomechanisms, concept of various types of systems.	21
II	**Servomotor:**DC and AC servomotors. **Signals:**Unit step, unit ramp, unit impulse and periodic signals with their mathematical representations and characteristics. **Time Response Analysis:**Time response of first and second order systems for unit step input, response specifications, steady state error and error constants. **Process Control:**Introduction of P, PI, PID controllers, their representations, characteristics and applications. **Stability:**Concepts of stability, Routh-Hurwitz criterion and determination of stability. **Frequency Response Analysis**: Correlation between time and frequency response of a second order system, polar plots, gain margin & phase margin and their determination.	21

Text Books:

- Bhimbra, P.S, "Electric Machines", Khanna Publishers.
- AshfaqHussain, "Electric Machines", Dhanpatrai& Sons.
- Nagrath&Gopal, "Control System Engineering", New age International.
- *B.S. Manke*, Linear Control Systems, Khanna Publishers.

Reference Books:

- Nagrath I. J. & Kothari D.P., "Electrical Machines", Tata McGraw Hill.
- Fitggerald A.E., Kingsley C. Jr. and Umans, "Electric Machinery", 6th Edition McGraw Hill.
- K. Ogata, "Modern Control Engineering", Prentice Hall of India.
-

Focus: This course focuses on Employability aligned with all COs.

Course Outcome: *After completion of course student will be able to*

1. *Analyze the connections of 3-phase transformer 3-phase induction motors and hence control their speed and their applications*
2. *Acquire knowledge about constructional details , principle of operation, starting and applications of DC motor, 3-phase induction motor, synchronous motors, stepper motor and PMDC motor.*
3. *Formulate the mathematical models of electromechanical systems and also able to describe various types of control systems and signals used.*
4. *Analyze the system stability using RH-critera, bode plot and R-locus and servo motors.*

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1, PSO3
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/PSO2, PSO3
CO4	PO1, PO2, PO3, PO4/ PSO2, PSO3

BEEO0900: ELECTRICAL MACHINES AND AUTOMATIC CONTROL LAB

Credits: 1 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I	1. To obtain magnetization characteristics of a D.C. shunt generator. 2. To obtain load characteristics of a compound generator (a) cumulatively compounded (b) differentially compounded. To obtain load characteristics of a D.C. shunt generator 3. To obtain speed-torque characteristics of a dc shunt motor. 4. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control 5. To perform polarity and ratio test on 3-phase transformer. To study various connections of 3-pahse transformers. 6. To study Scott connection of transformers. 7. To determine response of first order and second order systems for step input for variousvalues of constant 'K' using linear simulator unit and compare theoretical and practicalresults. 8. To study P, PI and PID temperature controller for an oven and compare their performance. 9. To study and calibrate temperature using resistance temperature detector (RTD) 10. To study PID Controller for simulation proves like transportation lag.	24

Outcome: *After successful completion of the lab student will able to*

CO1: Perform the experiment to analyze the characteristics of DC machines and Transformers.

CO2: Analyze system response and different controller.

Focus: This course focuses on Employability aligned with all COs.

Mapping of Course Outcomes(CO) With Program Outcomes(PO) and Program Specific Outcomes(PSO)

COs	POs/ PSOs
CO1	PO1,PO4/PSO1, PSO2

BEEO0092: NON CONVENTIONAL ENERGY RESOURCES

Objective: *To prepare thestudents for successful career in the energy industry; energy regulation and management agencies; and in the academic and R&D institutions.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction Various non-conventional energy resources-** Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. solar cell materials, solar cell power plant, limitations. **Solar Thermal Energy:** Solar radiation flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **Geothermal Energy:** Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. **Wave and Tidal Wave**: Principle of working, performance and limitations. Waste Recycling Plants.	21
II	**Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations. Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations. Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. **Wind Energy:** Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems. **Bio-mass:** Availability of bio-mass and its conversion theory. **Ocean Thermal Energy Conversion (OTEC)**: Availability, theory and working principle, performance and limitations.	21

Text Book:

- AndraGabdel, "A Handbook for Engineers and Economists".
- A. Mani , "Handbook of Solar radiation Data for India".

References Books:

- 3. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited byAcademic Press.
- 4. F.R. the MITTRE, "Wind Machines" by Energy Resources and Environmental Series.
- 5. Frank Kreith, "Solar Energy Hand Book".

Focus: This course focuses on Employability aligned with all COs.

Outcomes: *On successful completion of the program, the graduate would have attained the*

1. *Understood and acquired fundamental knowledge on the science of energy and on both the conventional and non-conventional energy technologies.*
2. *Acquired the expertise and skills needed for the energy monitoring, auditing and management, and for the development, implementation, and maintenance and auditing of Energy Management Systems.*
3. *Become capable of analysis and design of energy conversion systems.*
4. *Acquired skills in the scientific and technological communications, and in the preparation, planning and implementation of energy projects.*

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4,/ PSO1,
CO2	PO1, PO2, PO3, PO4,/ PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO4,/ PSO3
CO4	PO1, PO2, PO3, PO4/ PSO1, PSO3

COURSESTRUCTURE

B.TECH. MECHANICAL ENGINEERING

Under

Choice Based Credit System (CBCS)

S.No.	Department	Program Offered	Credits		Total Credits
1	ME	B.Tech. Mechanical Engineering	HSS	25	184-194
			BS	24	
			ES	28	
			PC	48	
			PE	26-36	
			OE	16	
			Proj	17	
			MNG	8 U	

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	CONTACTS HRS/WK
THEORY							
1.	BMAS0101	Engineering Mathematics – I	3	1	0	4	4
2.	BELH0001	English Language Skills for Communication I	1	2	0	2	3
3.	BPHS0001	Engineering Physics	3	1	0	4	4
4.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
5.	BEEG1001	Basic Electrical Engineering	3	1	0	4	4
PRACTICALS							
6.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
7.	BMEG0801	Engineering Drawing	0	0	2	1	2
8.	BEEG0801	Electrical Simulation Lab	0	0	4	2	4
9.	BELH0801	English Language Lab I	0	0	2	1	2
10.	BMEG0801	Engineering	0	0	2	1	2
	BPHS0801	Engineering Physics Lab	0	0	2	1	2
		Total	15	6	14	25	33

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	CREDITS	CONTACTS HRS/WK
THEORY							
1.	BMAS 0102	Engineering Mathematics – II	2	0	0	4	2
2.	BELH 0002	English Language Skills for Communication – II	1	2	0	2	3
3.	BCHS 0101	Engineering Chemistry	3	1	0	4	3
4.	BCSC 0001	Computer Programming	3	2	0	5	4
5.	B 0001	Electronics Engineering	3	1	0	4	4
6.	BMEG00 02	Applied Mechanics	3	0	0	3	3
PRACTICALS							

7.	BME G0802	Applied Mechanics Lab	0	0	2	1	2
8.	BECG 0800	Electronics Lab – I	0	0	2	1	2
9.	BCSC 0800	Computer programming lab	0	0	2	1	4
10.	BELH 0802	English Language Lab – II	0	0	2	1	2
11.	BCHS 0801	Engineering Chemistry Lab	0	0	2	1	2
		TOTAL	15	1	10	27	34

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
THEORY									
1	BMEC0001	MaterialScience	2	0	0	0	2	2	
2	BMEC0002	AppliedThermodynamics	3	1	0	0	4	4	BasicMechanical
3	BMEC0003	Measurement&Metrology	2	0	0	0	2	2	-
4	BMEC0004	Heat&MassTransfer	3	0	0	0	3	3	Applied
5	BMEC0005	FluidMechanics	3	0	0	0	3	3	Engineering
6	BMEC0006	ManufacturingScienceI	3	0	0	0	3	3	MaterialScience
7	BMEC0007	StrengthofMaterial	3	0	0	0	3	3	AppliedMechanics
8	BMEC0008	KinematicsofMachines	3	0	0	0	3	3	AppliedMechanics
9	BMEC0009	DynamicsofMachine	3	0	0	0	3	3	KinematicsofMachines
10	BMEC0010	MachineDesignI	3	0	0	0	3	3	StrengthofMaterial
11	BMEC0011	MachineDesignII	3	0	0	0	3	3	MachineDesignI
12	BMEC0012	FluidMachinery	3	0	0	0	3	3	FluidMechanics
13	BMEC0013	ManufacturingScienceII	3	0	0	0	3	3	ManufacturingScienceI
PRACTICALS									
1	BMEC0800	MaterialScience&TestingLab	0	0	2	0	1	2	
2	BMEC0801	Measurement&Metrology Lab	0	0	2	0	1	2	
3	BMEC0802	Heat&MassTransferLab	0	0	2	0	1	2	
4	BMEC0804	ManufacturingScienceILab	0	0	2	0	1	2	
5	BMEC0803	FluidMechanicsLab	0	0	2	0	1	2	
6	BMEC0805	TheoryofMachineLab	0	0	2	0	1	2	
7	BMEC0806	MachineDesignILab	0	0	2	0	1	2	
8	BMEC0807	MachineDesignII Lab	0	0	2	0	1	2	
9	BMEC0808	FluidMachineryLab	0	0	2	0	1	2	
10	BMEC0809	ManufacturingScienceIILab	0	0	2	0	1	2	
Total							48	58	

ProgramElective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS	PRE- REQUISITES
Bouquet: Thermal Engineering									
THEORY									
1	BMEE0001	Refrigeration & Air-Conditioning	3	0	0	0	3	3	AppliedThermo dynamics
2	BMEE0002	InternalCombustionEngine	3	0	0	0	3	3	AppliedThermo dynamics
3	BMEE0003	AutomobileEngineering	3	0	0	0	3	3	Internal CombustionEngine
4	BMEE0004	PowerPlantEngineering	3	0	0	0	3	3	AppliedThermo dynamics
5	BMEE0005	GasDynamics	3	1	0	0	4	4	AppliedThermo dynamics
6	BMEE0006	GasTurbineandJetPropulsion	3	1	0	0	4	4	AppliedThermo dynamics
7	BMEE0007	AdvancedHeatTransfer	3	0	0	0	3	3	HeatTransfer
8	BMEE0008	SolarEnergy	3	0	0	0	3	3	AppliedThermo dynamics
9	BMEE0009	IntroductiontoVehicl eDynamics	3	0	0	0	3	4	Automobil eengineeri ng
PRACTICALS									
1	BMEE0170	Refrigeration & Air-ConditioningLab	0	0	2	0	1	2	
2	BMEE0171	AutomobileEngineeringLab	0	0	2	0	1	2	
3	BMEE0172	SolarEnergyLab	0	0	2	0	1	2	
4	BMEE0173	VehicleDynamicsLab	0	0	2	0	1	2	
PROJECTS									
1	BMEE0186	ProjectbasedSolarEnergyLab	0	0	0	8	2	8	
Bouquet: Fluids Engineering									
THEORY									

1	BMEE0101	AdvancedFluidMechanics	3	1	0	0	4	4	FluidMechanics
2	BMEE0102	CompressibleFluidFlow	3	1	0	0	4	4	Advanced FluidMechanic s
3	BMEE0103	Aerodynamics	3	0	0	0	3	3	Advanced FluidMechanic s
4	BMEE0104	TurbulentFlow	3	1	0		4	4	Advanced FluidMechanic s
5	BMEE0105	ComputationalFluidDynamics	3	0	0	0	3	3	Numerical Methods&Turbule ntFlow
PRACTICALS									
1	BMEE 0189	Project Based CFD Lab	0	0	0	8	2	8	
2	BMEE0175	CFDLab	0	0	2	0	1	2	
Bouquet: Design Engineering									
THEORY									
1	BMEE0184	MachineDrawingLab	0	0	2	0	1	2	
2	BMEE0201	ComputerAidedDesign	3	0	0	0	3	3	MachineDesignII
3	BMEE0176	AdvancedSoftwareLab	0	0	2	0	1	2	
4	BMEE0202	ContunuumMechanics	3	1	0	0	4	4	StrengthofMaterial
5	BMEE0203	FiniteElementMethods	3	1	0	0	4	4	ContinuumMechanics
6	BMEE0204	VibrationandNoise	3	1	0	0	4	4	DynamicsofMachine
7	BMEE0205	MachineToolDesign	3	0	0	0	3	3	MachineDesignII&ManufacturingSc.
PRACTICALS									
1	BMEE0184	MachineDrawingLab	0	0	2	0	1	2	
2	BMEE0176	AdvancedSoftwareLab	0	0	2	0	1	2	
Bouquet: Manufacturing Engineering									
THEORY									
1	BMEE0301	Computer	3	0	0	0	3	3	ManufacturingScienceI

		AidedManufacturing							I
2	BMEE0302	WeldingScience&Technology	3	0	0	0	3	3	ManufacturingScienceI
3	BMEE0303	CompositeMaterials	3	0	0	0	3	3	MaterialScience
4	BMEE0304	Modern ManufacturingProcess	3	0	0	0	3	3	ManufacturingScienceI I
5	BMEE0305	MetalForming Analysis	3	0	0	0	3	3	ManufacturingScienceI
PRACTICALS									
1	BMEE0178	CAD/CAMLab	0	0	2	0	1	2	
2	BMEE0185	WeldingScience&TechnologyLab	0	0	2	0	1	2	
3	BMEE0179	Modern ManufacturingProcessLab	0	0	2	0	1	2	
PROJECTS									
2	BMEE0193	Project based ModernManufacturingProcess Lab	0	0	0	8	2	8	
3	BMEE0192	ProjectbasedCAD/CAMLab	0	0	0	8	2	8	
Bouquet: Industrial Engineering									
THEORY									
1	BMEE0401	IndustrialEngineering	3	0	0	0	3	3	
2	BMEE0402	Product Development &Design	3	0	0	0	3	3	MachineDesignII
3	BMEE0403	OperationsResearch	3	0	0	0	3	3	IndustrialE ngineering
4	BMEE0404	ValueEngineering	3	0	0	0	3	3	IndustrialE ngineering
5	BMEE0405	SupplyChainManagement	3	0	0	0	3	3	IndustrialE ngineering
6	BMEE0406	AppliedErgonomics	3	0	0	0	3	3	ProductDevelop ment& Design
Robotics & Automation									
THEORY									
1	BMEE0501	Robotics&FMS	3	0	0	0	3	3	IndustrialEngi neering
2	BMEE0502	IndustrialAutomation &ControlSystem	3	0	0	0	3	3	IndustrialEnginee ring

3	BMEE0503	EngineeringSystemModeling&Simulation	3	0	0	0	3	3	IndustrialEngineering
PRACTICALS									
1	BMEE0182	Robotics&FMSLab	0	0	2	0	1	2	
PROJECTS									
1	BMEE0196	ProjectbasedRobotics&FMSLab	0	0	0	8	2	4	-

Open Elective (Offer to other Departments)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMEO0002	EnergyConservation&Management	3	1	0	0	4	4	
2.	BMEO0003	SmartMaterials	3	1	0	0	4	4	
3.	BMEO0004	ProjectManagement	3	1	0	0	4	4	
4.	BMEO0005	ReliabilityandMaintenanceEngineering	3	1	0	0	4	4	
5.	BMEO0006	Mechatronics	3	1	0	0	4	4	
6.	BMEO0007	SixSigma&Applications	3	1	0	0	4	4	

Projects (J)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BME J0950	Mini Project I	0	0	0	4	2	4	
2.	BME J0951	Mini Project II	0	0	0	12	2	4	Mini Project I
3.	BME J0961	Industrial Training I	0	0	2	0	1	2	
4.	BME J0962	Industrial Training II	0	0	2	0	1	2	
5.	BME J0971	Minor Project	0	0	0	12	3	6	
6.	BME J0972	Major Project	0	0	0	32	8	16	Minor Project
		TOTAL	**0**	**0**	**4**	**60**	**17**		

Mandatory Non Graded Course (M)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
THEORY									
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
		TOTAL	**8**	**0**	**0**	**0**	**0**	**8**	

Humanities and Social Sciences (H)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purpose – I	2	0	0	0	2	2	
4.	BELH 0004	English for Professional Purpose – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAC0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH 0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	4	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	4	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

BMEG0001:BASICMECHANICALENGINEERING

Objective: *Precisethermodynamicseducationisarequirementtodiscussissuesthatonefacesinthermodynamics and resulting studiesin global warming, energy conversion and other energy related topicsthat affect sustainability of the environment in the global sense. Also introduce the students to various basicmanufacturingprocessescarriedoutinvariousindustriesverycommonly.*

Credits:04 **SemesterI/II** **L–T–P:3–1–0**

Module No.	Content	TeachingHours
I	**Fundamentals of Thermal Engineering:** Thermodynamic systems, State &properties, Thermodynamic equilibrium & processes, Heat & work, Workdone for different polytrophic processes, Zeroth law of thermodynamics andits applications, First law of thermodynamics, Steady flow energy equation,Applicationoffirstlawtovariousthermodynamicsystemsanditslimitations. **Second Law of Thermodynamics:** Concept of heat engine, heat pump &refrigerator,SecondLawofThermodynamics,CarnotCycle,Carnottheorem.	20
II	**ConceptofEntropy:**ClausiusInequality,Conceptofentropy,Entropychangeduringvarious processes. **Steam & its Properties:** Definition of pure substance, Phase change, p-Tdiagram and pV-T surfaces, Formation of Steam, Concept and determinationof dryness fraction of steam, Thermodynamic properties of steam, SteamtableandMollier diagram. **Introduction to Manufacturing Processes**: Mechanical properties ofmaterials, Engineering Materials: Plain carbon steel and its applications**Casting Process:**Patterns and typesof patterns andtheir allowances,Moulding sandanditsproperties,Elements of gating system**.** **Fabricationprocesses:**Introductionandclassificationofwelding,principleand applications ofShieldedMetalArcWelding andGas Welding.	20

TextBooks:

- YadavR.:"*ThermodynamicsandHeatEngines*":VolI&II (SlEdition)CentralPublishingHouseAllahabad, 2010.
- KumarD.S:"ThermalScienceandEngineering":S.KKatariaandSons,Delhi,2004.

ReferenceBooks:

- NagP.K.:"*EngineeringThermodynamics*":TMH,2017.
- Yadav R.: "*Thermodynamics and Heat Engines*" : Vol I & II (Sl Edition) Central Publishing HouseAllahabad, 2010.
- HajraChowdharySKandHajraChowdharyAK."*WorkshopTechnology*":MediaPromotors&Publishers,2010.
- RaghuwanshiRS,"*WorkshopTechnology*":DhanpatRaiandSons,NewDelhi,2012.
- WarkWenneth:"*Thermodynamics*":McGrawHillbookCo.NY,2015.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Attheendofthecoursethestudentwillbeableto:*

CO1:Understandthebasiclawsofthermodynamicsandtheirapplicationsinrealworld.
CO2: Calculateheatand energy transfer occur in atmosphereand incomponents under thermalengineeringapplications.
CO3:Interpretthebehaviorofsteamanditsapplicationsinthermalengineering.
CO4:Acknowledgetheapplicationofthermalengineeringassociatedwithhumanbody.
CO5:Understandthebasic industrial processes of metal joining,fabrication &castingwithapplicationsinrealworld.
CO6:Developbasicknow howandawarenessofvariousmanufacturingprocesses.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO7,PO6/PSO1
CO2	PO1,PO6,PO7/PSO1
CO3	PO1,PO7/PSO1
CO4	PO1/PSO1
CO5	PO1,PO5/PSO2
CO6	PO1,PO5/PSO2

BMEG0002 APPLIED MECHANICS

Objective: *Theaimoftheappliedmechanicsistoteachthe basicanalyticalmethodsthatisthefundamentalconceptsandtechniquesofengineeringmechanics.*

- *To givestudentspracticeinapplyingtheirknowledgeofmathematics,science,and engineeringandtoexpandthisknowledgeinto thevastarea ofAppliedMechanics.*
- *Toenhancestudents'abilitytodesignbyrequiringthesolutionofopenendedproblems.*
- *Topreparethestudentsforhigherlevel coursessuchascourses in MechanicsofSolids,MechanicalDesignandStructuralAnalysis.*

Credits:04 **SemesterI/II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:-** Mechanics:IdealizationofBodies,conceptofRigidBodies,ExternalForces,Moment andCouple,LawsofMechanics. **ForceSystemsAndEquilibrium:-** FundamentalConceptsandprinciplesofMechanics.Reductionofasystemofforcestoaforcecouplesystem,Concurrentforcesinaplane,FreeBodyDiagrams,Equations of equilibrium and their applications to various systems offorces. **Friction: - Friction forces and laws of dry friction,** Types of frictionandtheir applicationstoladderandbelt-pulleysystems **DistributedForcesandMomentOfInertia:-**BasicconceptsofCentroid, Area Moment of Inertia, Polar Moment of Inertia, Product ofinertia,Principalaxes,Parallelaxistheorem,Perpendicularaxistheoremandtheirapplicationsin Compositefigures.	22
II	**Beams:-**IntroductionofaBeamandits types**,**Conceptofbendingmoment and shear forces in beams, Shear Force and Bending MomentDiagramsfordifferentloadingconditions(pointload,uniformlydistributedload,uniformlyvaryingloadandcouple). **AnalysisofPlaneTrusses:-** Engineeringstructures,PerfectTruss,Determination of axial forces in the members, Method of Joints, MethodofSections. **KinematicsandKineticsofRigidBodies:-**Plainmotionofrigidbodies, Velocity and acceleration under translation and rotation, Work,PowerandEnergy, Impulseand Momentum,D'Alembert'sPrincipleand Lawof conservationofenergy.	23

Text Books:

- Tayal,A.K.EngineeringMechanics:Statics&Dynamics,14thEdition(2011),UmeshPublications,Delhi
- V.S.Mokashi,EngineeringMechanics:StaticsVol.I&DynamicsVol-II,(TataMcGraw-Hill),NewDelhi

Reference Books:

- Shames,I.H(1996),EngineeringMechanics,StaticsandDynamics4thedition,PrenticeHallofIndiaPvt.Ltd.,NewDelhi(EEE)
- F.P.Beer&E.R.Johnstonet.al.,VectorMechanicsforEngineers:StaticsandDynamics,12thEdition(2019)TMHNewDelhi

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Attheend ofthecoursethestudentwillbeableto:*

CO1:Understandtherepresentationandanalysisofforces,moments,andequilibriumofparticlesandrigidbodies,Conceptand principlesofworkand energy.
CO1:Theeffectoffrictionanditsroleinengineeringapplications.
CO2:Developbasicknowhowand awarenessto dealwith reallifeapplicationsinvarious fieldsofengineering.
CO3:Determine internal actions in statically determinate structures and draw internal action diagrams –
CO4:Shear Force(SFD)and Bending MomentDiagrams(BMD)forthesestructures.
CO5:Identifyanappropriatestructuralsystemtostudyagivenproblemandisolateitfromitsenvironment
CO6:Developconceptsofrigidbody kinematicsanddynamicswith anemphasisonthemodeling,analysis,andsimulation ofhowforcesproducemotionofrigid bodysystems.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2/PSO1
CO4	PO1,PO2/PSO1
CO5	PO1,PO2/PSO1
CO6	PO1,PO2/PSO1
CO7	PO1,PO2/PSO1
CO8	PO1,PO2/PSO1

BMEG0800: ENGINEERING WORKSHOP PRACTICE LAB

Objective: *The purpose of this lab is to enable the students to have the practical skills for basic manufacturingprocesses and to study the various tools & equipment used e.g. Machining, Surface finishing, Welding, Casting,Drawings (Developments), Measuring instruments. The student will also have practical exposure with varioussafetyprecautionsindifferentsectionsoftheshops.*

Credits:01 **L–T–P-J:0–0–2-**

Modul eNo.	Conten t	Lab Hour s
I	**<u>ListofExperiments</u>** **<u>MachineShop:</u>** **(1)** Tostudytheworkingofbasicmachinetoolslike Lathem/c,andDrillingm/c. **(2)** ToperformthefollowingoperationsonCentreLathe: **(i)** Centering,Facing,Turning,Stepturning,Taperturning. **(ii)** Knurling,Grooving,Chamfering,and Threading. **<u>WeldingShop:</u>** **(1)** TopreparelLapjoint,Buttjoint,T-jointbyusinganElectricArcwelding. **(2)** TopreparelLapjoint,Buttjoint,T-jointbyusinganOxy-Acetylenegaswelding. **<u>CarpentryShop:</u>** **(1)** To performdifferentoperationsin Carpentryshop such ascutting,planningandchiselingonthegivenwoodenpiece. **(2)** TopreparelajointLapjoint,T-Joint,Dovetailjointbyusingwoodenspecimen/piece. **<u>FoundryShop:</u>** **(1)** To prepareaSandmouldforsolidcastingwiththehelpsinglepiecepattern&splitpattern. **(2)** Topreparethemouldforhollowcasting withthehelpofpatternand core. **<u>SheetMetalShop:</u>** **(1)** Todeveloptheblankdimensions forthegivenproductusingdevelopmentprocess. **(2)** TopreparelaFunnelofrequireddimensionsusingjoiningprocesses. **<u>FittingShop</u>:** **(1)** To performtheoperationsofMarking,FilingandSawingonthe givenmetallicwork-piece(M.S.)as pergivendimensions. **(2)** Toperformtheoperationsofdrillingofmakingtheholesonthegivenmetallicwork-piece(M.S.)byuseofDrillingmachine. **(3)** Toperformtheoperationsofmakinginternalthreadsbyuseoftapesanddies.	30

Text/ReferenceBooks:

- *JohnK.C.,“MechanicalWorkshopPractice”:PHILearningPvt.Ltd.,NewDelhi,2010.*
- *ChoudharyHajra,“ElementsofWorkshopTechnology”:MediaPromoters&PublishersPvt.Ltd.,Mumbai ,2010*
- *ChapmanW.A.J.,“WorkshopTechnology”,CBSPublishers&Distributors,NewDelhi,2007*

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:*Onsuccessfulcompletionofthislab,thestudentswillbeableto:*

CO1:Demonstrateanunderstandingofandcomplywithworkshopsafetyregulations.
CO2:Selectandperformarangeofmachiningoperationslike:turning,facing,knurlingdrilling,grindingetc. toproduceagivenjob.
CO3:Acquirebasicknowledgeofwelding,jointdesignsuchasLapjoint,LapT-joint,Edgejoint,ButtjointandCornerjointandtheapplicationofwelding.
CO4:AbilitytodesignandmodeldifferentprototypesinthecarpentrytradesuchasCrosslapjoint,Dovetailjoint.
CO5:AbilitytodesignandmodelvariousbasicprototypesinthetradeoffittingsuchasStraightfit,V-fit.
CO6:AbilitytomakevariousbasicprototypesinthetradeofTinsmithysuchasrectangulartray,andopenCylinder.
CO7:Studentwillabletodesignmouldwiththehelpofgreensandmould.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1
CO2	PO1,PO3/PSO1
CO3	PO1,PO3/PSO1
CO4	PO3/PSO1
CO5	PO3/PSO1
CO6	PO3/PSO1
CO7	PO3/PSO1

BMEG 0801 ENGINEERING DRAWING

Objective: *Technical drawing is the language of engineering. The objective of this course is to learn initially thebasic principles involved in the projection of points, lines, lamina and solids. As well this course isfocusedtowards the interpenetration of solids, development of surfaces, isometric drawings and some basics of computeraided drafting software. It is expected that a student should learn this subject in a verysystematicway todeveloptheskilltoexpresseffectivelyhis/herideaaboutanobjecttoothersthroughdrawings.*

Credits:01 **SemesterI/II** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**Introduction** Drawinginstrumentsandtheiruses,BISconventions,letteringdimensioningand freehandpracticing (2 Drawing sheets)**Geometricconstruction&engineering Scales** Basicgeometricconstruction-Dividingagivenstraightlineintoanynumber of equal parts, drawing a regular polygon given one side, conicsections – ellipse – parabola. Concepts of scales –Plain, Diagonal & scaleofchord.(2Drawingsheets) **Orthographicprojection** Introductiontoprojection&orthographicProjections *Projectionsofpoints*lyinginfourquadrants *Projectionoflines*-parallelandinclinedtooneorbothplanes *Projectionofplanes*-inclinedtooneorbothplanes. *Projectionsofsolids*-axisperpendiculartoHP,axisperpendiculartoVPandaxis inclinedtooneorbothplanes. (4 Drawing sheets)**Sectioning of solids-** Section planes perpendicular to one plane andparallelorinclined tootherplane. (1Drawingsheets)**Development of surfaces-** Development of prisms, pyramids andcylindrical&conicalsurfaces (1Drawingsheets)**Isometric projection -**Isometric projection and isometric views ofdifferentplanesandsimplesolids (1Drawing sheets) **Computeraideddrafting**Introductiontocomputeraideddraftingpackageto make2-Ddrawings.	24

TextBooks:

- Venugopal,K.andPrabhuRaja,V.:‘EngineeringDrawingandGraphics+AutoCAD’:NewAgeInternational,2017.
- Agrawal&Agrawal,C.:‘EngineeringDrawing’:TataMcGrawHill,2014.

ReferenceBooks:

- Bhatt,N.D.andPanchal,V.M.,‘EngineeringDrawing’:CharotarPublishingHouse,2010.

- Natarajan,K.V.,'AtextbookofEngineeringGraphics':DhanalakshmiPublishers,Chennai,2014.
- Venugopal,K.andPrabhuRaja,V.,'EngineeringDrawingandGraphics+AutoCAD':NewAgeIntern ational,2017.
- Jolhe,D.A.,'Engineeringdrawing':TataMcGrawHill,2010.
- TrymbakaMurthy,S.,'ComputerAidedEngineeringDrawing':I.K.InternationalPublishingHouse,200 8.
- Agrawal&Agrawal,C.,'EngineeringDrawing':TataMcGrawHill,2014.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcomes: *At the end ofthecoursethestudentwillbeableto*

CO1:Knowandunderstandtheconventionsandthemethodsofengineeringdrawing.

CO2:Interpretengineeringdrawingsusingfundamentaltechnicalmathematics.

CO3:Improvetheirvisualizationskillsso thattheycanapplytheseskillsindevelopingnewproducts.

CO4:Improvetheirtechnicalcommunicationskillintheformofcommunicativedrawings.

CO5:Comprehendthetheoryofprojection,Interpretviewsandsectionalviewsandprojections.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO3/PSO1
CO4	PO10/PSO1
CO5	PO3/PSO1

BMEG0802 APPLIED MECHANICS LAB

Objective:*Thiscourseintroducesthefundamentalsofstaticsinengineering,whicharepreprerequisites for further study of advanced mechanics. The main objective of the course is tolearn basic principles of static in mechanics analyses, such as rigid bodies, friction between twosurfaces, centroid, reaction of beam, Newton's laws of motion and analysis of truss. It alsoincludesarangeofessential stepsforsolving problemsinstatics..*

Credits:01 **SemesterVI** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
1	**ListofExperiments:** • Studyoffunctioningofgeartrains. • Tofindthemechanicaladvantages,velocityratioandefficiencyofwormandwormwheel. • Tofindthecoefficientoffrictionbetweenthesurfaceofagivenwoodslidebarandaninclinedplane. • Tofindcentreofgravityofdifferentgeometricalobjects. • Deflectionofsimplysupportedbeamandverificationoftheoreticalvalues. • Tofindreactionatthesupportsofasimplysupportedbeamwithdifferent typesofloading. • Todeterminethemodulusofrigidityofrodwiththehelpoftorsiontestingmachine. • Tostudyfunctioningofbeltpulleysystems. • Tofindmomentofinertiaofaflywheelabouttheaxisofrotationusing electroniccountermachine. • Tofindforcesinmembersofatrussfordifferentload ○ conditions.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Attheendofthecoursethestudentwillbeable

- *To know the practical skills to analyze the forces, moments, and their equilibrium.*
- *To know the practical skills to analyze the effect of friction.*
- *To develop basic, know how and awareness to deal with practical aspects ofapplied mechanics.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2/PSO1

BMEG0803 COMPUTER AIDED DRAFTING LAB

Objective:*Theobjectiveofthiscourseistoteachusersthebasiccommandsandtoolsnecessaryforprofessional2D drawing,design anddraftingusingAutoCAD.*

Credits:01 **SemesterI/II** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**GettingStart–** Startingwithautocad,openandsavefiles,toolbars,screenlayouts. **BasicDrawing&EditingCommands-** DrawingLines,rectangles,Circles,viewingDrawing,Undo&Redocommands,Erasingobjectsetc. **DrawingPrecision-** UsingObjectsnap,Osnapoverrides,Polartrackingsettings,DrawingwithSNAP&GRID,function keys. **ChangesinDrawings-** Selectingobjectforediting,Movingobjects,copying,Rotatingobject,Scaling,mirroringeditingwithGrips. **DrawingOrganization&InformationLayers** Templates,Layers,LayerState,changingobjectlayers,etc. **AdvanceEditingCommands-** Trimming & extending, Stretching, Creating Fillets and Chamfers,Offset,creatingarraysofobjects. **Blocks** InsertionofBlockfromtoolPalettes,usinginsert,withdesigncentre. **Annotation-** Text,Hatching,Dimensions **3DModeling-** Introduction, basic tools, 3D navigation tools, UCS.Formationofsimplesolids,solidprimitives,meshmodel. **Creatingsolid**from 2D–Extrude,Swept,revolvesolid,loftedsolid. **EditingSolid**-Editingfacesofsolid,Filletandchamfer onsolids 2dviewfrom 3d.Multipleviewports	24

TextBooks:-

- TrymbakaMurthy,S.,'ComputerAidedEngineeringDrawing',Pub-I.K.InternationalPublishingHouse.
- Venugopal,K.and Prabhu Raja,V.,'EngineeringDrawingand Graphics+AutoCAD',Pub-NewAgeInternational

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletingthiscoursethestudentwillbeableto:

CO1:UseAutoCADfordailyprocesses requiringdesigninganddrafting.
CO2:NavigatethroughoutAutoCADusingmajornavigatingtools.
CO3:Understandtheconceptandtechniquestodrawtypicalgeometries.
CO4:Createmultipledesignsusingseveraltools.
CO5:Createlayerstocontroltheobjects'visibility.
CO6:Explaindrawingusingannotations.

MappingofCourseOutcomes(Cos)withProgrammeOutcomes(Pos)andProgrammeSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO9/PSO1
CO2	PO3,PO4,PO5/PSO3
CO3	PO1,PO2,PO3/PSO3
CO4	PO1,PO2,PO5/PSO1
CO5	PO1,PO3,PO10/PSO3
CO6	PO1,PO5,PO10/PSO3

BMEC0011 MATERIAL SCIENCE

Objective: *To introduce the fundamentals of biomaterials, nanomaterials, ceramics, metals, polymers,electronic materials and composites, smart materials, green and sustainable materials emphasizingthe relationships between atomic structure and microstructure as well as the properties, processingandperformanceofthematerialinacohesiveandself-containedwaywithinthecourse.*

Credits:02 **L–T–P:2–0–0**

Module No.	Content	Teaching Hours
I	**CrystallographyandImperfections:**ConceptofUnitCellSpaceLattice,Bravais-Lattices,AtomicPackingFactorandDensitycalculations,Millerindices,ImperfectionsandDislocationsinSolids. **Introduction to Non Destructive Testing:** Liquid penetrant Testing,MagneticParticleTesting,UltrasonicTesting,EddycurrentTesting, Radiography,X-RayCrystallography. **Fatigue**: Stress cycles, Factors affecting fatigue, application of fracturemechanics to fatigue crackpropagation, **Creep:**Creepcurve,stagesincreepcurveandexplanation,creepmechanisms,metallurgicalfactors affectingcreep. **StrengtheningMechanism:**ConceptofGrainandGrainBoundary,Hall-Petchstrengthening,Solidsolutionstrengthening,precipitationstrengtheninganddispersionstrengthening.	22
II	**Equilibrium Diagrams:** Types of Equilibrium-Diagrams: Solid-SolutionType, Eutectic Type and Combination Type. Iron-Carbon Equilibrium-Diagram andItsImportance. **Heat Treatment:** Various Types of Heat Treatment Such As Annealing,Normalizing,Quenching,TemperingandCaseHardening.TimeTemperatureTransformation(TTT)Diagrams. **CorrosionScience:**Definitionandimportance,Electrochemicalreactions, Polarization, Passivity, Environmental effects, Eight forms ofcorrosion, **Prevention and control of corrosion:** Cathodic protection,Coatings andinhibitors. **PropertiesandApplication:**ConceptofMagnetismandMagneticmaterials,Ceramics,Superconductorsanditstypesandphenomenonof Superconductivity, Metallic foams, Polymers, Composites, Carbon fibre,Graphene,NanoMaterials, SmartMaterials.	22

TextBooks:

- GuptaK.M.,"*MaterialsScience*",UmeshPublication.
- RaghvanV.,"*MaterialScience*",PrenticeHall.
- Narula,"*MaterialScience*",TMH.
- Fontana,M.G.,"*CorrosionEngineering*",TataMcGraw-Hill.

ReferenceBooks:

- CallisterW.D.,JR,"*MaterialScience&Engineering*",Addition-WesleyPublication.
- VlackVan,"*ElementsofMaterialScience&Engineering*",JohnWiley&Sons.
- Avner"IntroductiontoPhysicalMetallurgy"TMHPub

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletingthiscoursethestudentwillbeableto:

CO1:Understandingofthecorrelationbetweentheinternalstructureofmaterials,theirmechanicalproprtiesand
CO2:Understandingofvariousmethodstoquantifytheir mechanicalintegrityandfailurecriteria
CO3:Understandingof detailed interpretationofequilibrium phasediagrams.

CO4:BasicUnderstandingofdifferentphasesandheattreatmentmethodstotailorthepropertiesof Fe-C alloys
CO5: Knowledge of various alloying elements, their properties and applications.CO6:knowledgeof smart materials andtheiruniqueapplications

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PO3/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEC 0800: MATERIAL SCIENCE AND TESTING LAB

Objective: *To introduce the microstructure of solids in reference to solids viewed at the subatomic (electronic) and atomic levels, and the nature of the defects at these levels. The microstructure of solids at various levels profoundly influences the mechanical, electronic, chemical, and biological properties of solids. The phenomenological and mechanistic relationships between microstructure and the macroscopic properties of solids are, in essence, what materials science is all about.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**ListofExperiments** • ToPrepareSpecimenforMicroStructuralExamination-Cutting,Grinding, Polishing,Etching. • ToStudyCrystalStructuresandCrystalsImperfectionsUsingBallModels. • ToStudyBravaisLattice withHelpofModels. • ToDeterminetheGrainSize ofAGivenSpecimen. • Make A Comparative Study of Microstructures of Different GivenSpecimens after Micro Structural Examination (Mild Steel, Gray C.I.,Brass,CopperEtc.) • HeatTreatmentExperimentsSuchAsAnnealing,Normalizing,Quenching,CaseHardeningandComparisonofHardnessbeforeandAfter. • ToDeterminetheStrengthByTestingofAGivenMildSteelSpecimenonUTM WithFullDetailsand PlotontheMachine.	12
II	• ToConductShearandBend TestsonUTM. • To Conduct Impact Testing on Impact Testing Machine Like Charpy,Izodor Both. • ToConductHardnessTestingofGivenSpecimenUsingRockwellandVickers /Brinell TestingMachines. • ToCalculatetheDeflectionofBeamandYoung'sModulusofElasticityofaMaterialofaBeamSimplySupportedat theEnds. • ToConductTorsionTestingofARodonTorsionTestingMachine. • ToDeterminetheSpringIndexTestingonSpringTestingMachine. • ToPlotACurveBetweenStrainVsTime(E-T)forCreepTestingonCreepTestingMachine. • StudytheMicrostructureofWeldedComponentandHAZ(HeatAffectedZone)MacroandMicroExamination.	12

TextBooks:

- W.D.Callister,2006,"MaterialsScienceandEngineering-AnIntroduction",6thEditionWileyIndia.
- Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall ofIndiaPrivateLimited, 4thIndian Reprint, 2002.

ReferenceBooks:

- Raghavan,“MaterialScienceandEngineering’,PrenticeHallofIndiaPrivateLimited,1999.
- MechanicsofmaterialsbyJames M.Gere.
- IntroductiontoengineeringmaterialsbyB.K. Agarwal.
- Physicalmetallurgyandadvanced materials byR.E. Small man.
- EngineeringmechanicsofcompositematerialsbyIsaacM.Daniel.
- U.C.Jindal,“EngineeringMaterialsandMetallurgy”,Pearson,2011.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Aftercompletionofcourse,thestudentwill beableto:

CO1:Understandthevarious crystalstructureusingball andstickmodels.
CO2:Todemonstrate,analyseandpredictthemechanicalbehaviourpresentindifferentengineeringmaterials such as CI, MS etc.
CO3:TounderstandtheworkingofhardnesstestingmachineslikeRockwell,Brinell'shardnessmachinesand instruments likedial gauge,VarnierCallipersetc.
CO4:Understandthevariousheat-treatmentmethodsandtheireffectonmicrostructureandmechanicalproperties
CO5:Understandthepropertiesofmaterialsusingdestructivetesting.

COs	*POs/PSOs*
CO1	*PO1/PSO3*
CO2	*PO1/PSO3*
CO3	*PO1/PSO3*
CO4	*PO1/PSO3*
CO5	*PO1/PSO3*

BMEC 0002 APPLIED THERMODYNAMICS

Pre-requisite: *BasicMechanicalEngineering*
Objective: *Toapplybasicsofthermodynamicsandphysicsindesignofthermodynamicssystems.*

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Basics of thermodynamics:** Learning Objective, Definition, First law,Secondlaw,conceptofentropy,differentialentropyrelations. **ThermodynamicsRelation:**,LearningObjective,Introduction,Helmholtz and Gibbs Function, Maxwell Relation, Chaperon Equation,Joule Thompson Coefficient and Inversion Curve, Coefficient of VolumeExpansion,AdiabaticandIsothermalCompressibility. **AvailabilityandIrreversibility:**LearningObjective,Introduction,AvailableandUnavailableEnergy,AvailabilityandIrreversibility,SecondLawEfficiency.**SteamGenerator:**LearningObjective,Introduction,Steamproperties,FunctionofBoilers,ClassificationofBoilers, Modern Boilers, Working of Fire Tube and Water Tube Boiler,Mountings and Accessories, Draughtand ItsCalculation, PerformanceofBoilers.Heatbalancesheetofboiler. **Condensers and Cooling Towers:**Learning Objective, Introduction,FunctionofCondenser,CondensingSystem,SurfaceandJet Condensers,MassofCirculatingWater,CondenserandVacuumEfficiency,Cooling Tower:Construction Details andAnalysis.	22
II	**VapourPowerCycle:**LearningObjective,Introduction,ReviewofCarnot and Rankine Cycle, Effect of Operating Conditions on ThermalEfficiency of Rankine Cycle, Principle Methods of Increasing ThermalEfficiency,DeviationofActualCycleFromTheoreticalCycle,RegenerativeFeedHeatingCycles,ReheatingandRegenerativeCycles ,Binary Vapour Cycle. Case study of design and installation of thermalpower plant of 500 MW to fulfill requirement of small medium city .**FlowThroughNozzlesandDiffusers:**LearningObjective,Introduction,ClassificationofNozzlesandDiffusers.SteadyFlowEnergy Equation Through Nozzles, Momentum Equation. Nozzle andDiffuser Efficiencies, Mass Flow Rate Through Nozzle Under IsentropicFlowCondition,GeneralRelationship,BetweenArea,VelocityandPressureinNozzlesandDiffuser,SupersaturatedFlowThroughNozzles,EffectofVariationofBackPressureinNozzle. **SteamTurbines:**LearningObjective,Introduction,PrinciplesofWorkingofSteamTurbines,Classification&Comparison,VelocityDiagramFor ImpulseandReactionTurbines.Staging,StageandOverall Efficiency,Reheat Factor,Bleeding.	23
	Totalcontacthours(lectures)	45

TextBooks:

- Domkundawar S, Kothandaraman C.P, Domkundawar A.V "Thermal Engineering" Dhanpat Rai &Sons.
- Yadav R., "*Steam & Gas turbines and Power Plant Engineering*", VII ed., 2004, Central Publishing HouseAllahabad.
- RajputR.K.,"*ThermalEngg*."DhanpatRai&Sons.
- NagP.K.,"*BasicandAppliedThermodynamics*",TMHPublicationNewDelhi.
- KeartonW.J.,"*TheoryofSteamTurbine*", DhanpatRaiandSons

ReferenceBooks:

- YunusA.Cengel. AndMichaelA.Boles., "Thermodynamics:AnEngineering Approach",McgrawHillEducation
- Ennis W.D.,"AppliedThermodynamicsForEngineers",D.VanNostrandCompany.
- Davies D.,Jeremy.,"ConciseThermodynamics:PrinciplesandApplications",HorwoodPublishing
- McConkeyA.andEastopT.,"AppliedThermodynamicsforEngineeringTechnologists"PearsonIndia

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Aftercompletingthissubjectstudentswillbeableto:*
CO1.Determinetheavailabilityandirreversibilityofopenandclosedsystemthermodynamiccycles.(Understand)
CO2. Understand Maxwell's and thermodynamic relations of gas mixtures.(Understand)CO3.Understandtheworkingofboilersandevaluate theboilerperformance.(Understand)
CO4.EvaluatethethermalefficiencyofRankine cycle,regenerativecycleandreheatcycle.(Understand)
CO5.UnderstandtheworkingofcondensersandcoolingtowersandevaluatetheCondensersefficiencyandvacuum efficiency.(Understand)
CO6.Understandbasicconcepts,energyequationsandworkingofnozzleanddiffuser.(Understand)
CO7.Understandtherelationshipbetweenarea,pressureandvelocityofsteamnozzlesanddiffusersandevaluatethe efficiencyofnozzlesanddiffusers.(Understand)
CO8.Analyzeimpulseandreactionsteamturbomachinesforenergytransfer.(Apply)

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	PSO/PO
CO1	PSO1/PO1/PO2/PO5/PO6
CO2	PSO1/PO1/PO2
CO3	PSO1/PO1/PO2/PO6
CO4	PSO1/PO1/PO5/PO6
CO5	PSO1/PO1/PO5/PO6
CO6	PSO1/PO1/PO5/PO6/PO7
CO7	PSO1/PO1/PO3/PO5/PO6/PO7
CO8	PSO1/PO1/PO3/PO5/PO6/PO7

BMEC0003MEASUREMENTANDMETROLOGY

Objective:

Todevelopinstudentstheknowledgeofbasicsof Measurements,MetrologyandMeasuringdevices.

Credits:02 **Semester IV** **L–T–P:2–0–0**

ModuleNo.	Content	Teaching Hours
I	**Introduction to measurement:** Generalized measuring system and itsfunctionalelement,unitsofmeasurement,staticcharacteristicsofmeasuringinstruments,SystematicandRandomerrors,Statisticalanalysis of errors,Calibration. **Measurementofgeometricforms:**Measurementofroundness,flatness andstraightness. **SensorsandTransducers:**Introductiontosensorsandtransducers.**Limits, fits and Tolerances:** Interchangeability, selective assembly,limits,fit andtolerances,limitgauging,design oflimitgauges.	15
II	**StrainMeasurement:**TypesofStrainGaugesandTheirWorking,StrainGaugeCircuits,TemperatureCompensation. **MeasurementsofForceandTorque:** IntroductiontoDevicesused forMeasuring ForceandTorque. **LinearMeaurementandAngularMeasurement:** Steelrule, verniercaliper,vernierheightgauge,verniermicrometers,Anglegauges,sinebar,slipgauges,vernierbevelprotractor. **SurfaceTexture:**SurfaceRoughness,QuantitativeEvaluationofSurfaceRoughness andItsMeasurement. **Comparators:**Sigmacomparator,Johansson'sMicrokrator.	17

TextBooks:

- KumarD.S.,"*MechanicalMeasurementsandControl*",Metropolitan,N.Delhi.
- TayalA.K.,"*InstrumentationandMechanicalMeasurement*",GalgotiaPublishers.
- JainR.K.,"*Measurement&Metrology*",KhannaPublications.

ReferenceBooks:

- DobilinErnest,"*MeasurementSystemsApplicationandDesign*",TMH.
- Bewoor.,"Metrology&Measurement",TMHpublicationnewDelhi.
- KennethJohnHume.,"Engineeringmetrology",Macdonald.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

At theend of thiscoursestudentswill beableto

*CO1.Understandthemeasurementsystems,unitsanddimensionsandcharacteristicsofmeasuringinstruments.**(Understand)***

*CO2.Explainthevariousformmeasurementslikestraightness,flatness,roundness.**(Understand)***

*CO3. Understand working of suitable instruments for typical measurements like strain, force andtorque.**(Understand)***
*CO4. Identifymethodsanddevicesformeasurementoflengthand angle.**(Understand)**CO5.Understand concepts of limits, fits and tolerances in industrial application. **(Apply)**CO6.Designoflimitgauges.**(Apply)***
*CO7.Determineandmeasureofsurfaceroughness.**(Understand)***

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	PSO/PO
CO1	PSO1/PSO2/PSO3/PO1/PO6
CO2	PSO2/PSO3/PO1/PO2/PO6
CO3	PSO2/PSO3/PO1/PO2/PO6
CO4	PSO2/PSO3/PO1/PO2/PO3/PO6
CO5	PSO2/PSO3/PO1/PO5
CO6	PSO3/PO1/PO3/PO5
CO7	PSO2/PSO3/PO1/PO3/PO5

BMEC0801MEASUREMENTANDMETROLOGYLAB

Objective: *Toeducatestudentsondifferentmeasurementinstrumentsandoncommontypesof errors.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**ListofExperiments:** • ToFind OuttheErrorinthemeasurement ofthegivenspecimenUsingVernierCaliper. • ToAnalyzedtheDeviationinDiameterofAGivenSpecimenUsing Micrometer. • ToMeasuretheAngleofAGivenSpecimen(WoodenBlock)Using SineBarandSlipGauges. • To Study the Limit Gauge For Better Understanding of Limits,Fits andTolerances. • ToObservetheAngularMeasurementsofAGivenSpecimenUsing VernierBevelProtector. • ToPerformStrainMeasurementinCantileverBeamUsingStrainGaugeByApplyingtheDifferentLoads. • ToFind OuttheCircularityofACylindricalRodUsingDialGaugeIndicatorandV-Block. • ToFindOuttheSpeed ofAnyRotatingPart(I.E.,CeilingFan)Using Stroboscope(Non-ContactDevice). • ToMeasuretheHeightofAGivenSpecimenUsingHeightGauge. • ToDeterminetheTemperatureofAHeat BathUsingResistanceTypeDetector(RTD) andThermocouple. • ToMeasuretheLinearDisplacementUsingLinearVariableDifferentialTransformer(LVDT). • ToMeasurethePressureUsingBourdonGaugeandStrainGauge. • To Determine the Torque of A Rotating Shaft Using Strain GaugeCoupledWithTorqueSensor. • ToFindOuttheFlatnessofASurfacePlateUsingSpiritLevel. • To determine the various elements of a threaded specimen withthehelpof profileprojector.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *At theend of thiscoursestudentswill beableto*
CO1.UnderstandanddetermineerrorinthemeasurementusingVerniercalliperandMicrometer. ***(Understand)***
*CO2.DetermineangleusingsinebarandVernierbevelprotractor.**(Understand)***
*CO3. Understand limits,fitsandtolerancesusing limit gauges.**(Apply)***
CO4. Understand theconcept ofcircularityusingcircularityteston Vblockand dialgauge.

(Understand)
CO5.Determinetheelementsofathreadedspecimenwiththehelpofprofileprojector. ***(Apply)***
CO6. Determinespeedofrotatingpartusing noncontactabledevice. ***(Understand)***
CO7.UnderstandworkingofLVDT,RDT,Thermocouples,straingaugeandbourdongauge.
(Understand)
CO8. DetermineheightusingVernierheightgauge. ***(Understand)***

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**PSO/PO**
CO1	PSO2/PSO3/PO1/PO3/PO5/PO6
CO2	PSO2/PO1/PO3/PO6/PO5
CO3	PSO2/PSO3/PO1/PO5
CO4	PSO2/PSO3/PO1/PO3/PO5/PO6
CO5	PSO2/PSO3/PO1/PO3/PO5
CO6	PSO1/PSO2/PSO3/PO1/PO5
CO7	PSO1/PSO2/PSO3/PO1/PO3/PO5/PO6
CO8	PSO2/PSO3/PO1/PO5

BMEC0004HEAT&MASSTRANSFER

Pre-requisite:AppliedThermodynamics
Objective:Todeveloptheunderstandingofbasicofheattransfermechanismandtheirapplicationinindustry.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Heat Transfer:** Basic concepts of heat transfer, Effect ofTemperature on Thermal Conductivity of Materials; Introduction to CombinedHeatTransferMechanism,EngineeringApplicationsofHeatTransfer. **Conduction:** Fourier's law of heat conduction for homogeneous, isotropicmedia, One-Dimensional General Differential Heat Conduction Equation in theRectangular, Cylindrical and Spherical Coordinate Systems (Case of constantthermal conductivity); Significance of thermal diffusivity, Initial and BoundaryConditions. **SteadyStateOne-DimensionalHeatConduction:**CompositeSystemsinRectangular, Cylindrical and Spherical Coordinates With and Without EnergyGeneration;ThermalResistanceConcept;AnalogyBetweenHeatandElectricityFlow;ThermalContactResistance;CriticalThicknessofInsulation. **ExtendedSurfaces(Fins):**Introduction,types,Generalequations,Finefficiencyandeffectiveness,FinsofUniformCross-SectionalArea,Finapplications. **Transient Conduction:** Transient Heat Conduction; Lumped CapacitanceMethod; Non-dimensional numbers in conduction – Significance of Biot andFouriernumbers,TimeConstant;UnsteadyStateHeatConductioninOneDimensionOnly,HeislerCharts. **NaturalConvection:**PhysicalMechanismofNaturalConvection;Characteristic Length,Non-dimensionalnumberswiththeirsignificanceEmpirical Heat Transfer Relations for Natural Convection Over Vertical PlanesandCylinders,Horizontal PlatesandCylinders.	20
II	**ForcedConvection:**BasicConcepts;HydrodynamicBoundaryLayer;ThermalBoundaryLayer;energyequation,ConcentrationBoundaryLayerNon-dimensionalnumberswiththeirsignificanceLocalandaverageheattransfer coefficients, Flow Over a Flat Plate; Empirical Heat Transfer Relations;**Radiation:**GrayBody;ShapeFactor;Black-BodyRadiation;RadiationExchange Between Diffuse Non Black Bodies in An Enclosure; Radiation Shields;Radiation from cavities, Electrical Analogy of Radiation Heat Transfer; SolarRadiation. **Heat Exchanger:** Introduction ,Types of Heat Exchangers; Fouling Factors;OverallHeatTransferCoefficient;Analysisofheatexchangers:LogarithmicMeanTemperatureDifference(LMTD)Method;Correctionfactorcharts,Effectiveness-NTUMethod;,HeatPipes **CondensationandBoiling:**IntroductiontoCondensationPhenomena;Dropwise Condensation;BoilingModes, Pool Boiling;	20

TextBooks:

- YadavR.,“*HeatTransfer*”,CentralPublishingHouse,Allahabad,2018
- Rajpoot,R.K.“HeatandMassTransfer”,S.ChandPublications,2018
- D.S.Kumar,“HeatandMass Transfer”S.KKataria&sons, 2008

ReferenceBooks:

- Bayazitouglu&Ozisik,“*ElementsofHeattransfer*”,T.M.H.,2015
- HolmanJ.P.,“*HeatTransfer*”,McGraw-HillInternationaledition.2016
- Pitts&Sisson,“*Schaum'soutlineofHeatTransfer*”,McGraw-HillInternationaledition,2018
- FrankKreith,“*PrinciplesofHeatTransfer*”,McGraw-HillBookco.,2019

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletionofcourse,thestudents will beableto:

*CO1.*Determinetheoverallthermalconductivityofcompositewallofa Furnace.
*CO2.*Determinethe criticalthicknessofinsulationofsteampipesofthermalpowerplant.
*CO3.*EvaluatetheeffectivenessandefficiencyofheattransferofFinsofmotorbikeengine.
*CO4.*Determinetheheattransfereffectivenessofshellandtubeheatexchangers.
*CO5.*Understandmassdiffusion rateincaseofevaporativecooling incoolingtowers.
*CO6.*Understandthe effectsoffoulinginboilertubesofthermalpowerplant.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO1,PO2/PSO1,PSO2
CO6	PO1,PO2/PSO1,PSO2

BMEC 0802HEATANDMASSTRANSFERLAB

Objective: *Heat Transfer is one of the important subjects which is commonly applied in renewable energy,industrial, commercial and domestic systems. The experiments are designed to provide exposure of practicalaspects of the various theoretical concepts developed under the course, Heat and Mass Transfer. The laboratoryconsistsofexperimentsonvariousconductive,convective,radiative,boilingmechanismsofheattransfer.*

Credits:01 **SemesterV** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments • ToDeterminetheOverallHeatTransferCoefficientForaCompositeWall • TodeterminethethermalConductivityofaMetallicRod andDraw a Graph Between Variation in Conductivity andTemperature. • To Determine the Heat Transfer Rate Through the CompositeCylinder and the Overall Heat Transfer Coefficient of CompositeSystem • ToDeterminethethermalConductivityofLiquid • ToDeterminethethermalContactResistanceofaCompositeWall • ToDeterminetheCriticalThicknessof insulationofaLaggedPipe. • To Determine the Heat Transfer Through a Heat Pipe & Draw aTemperatureDistributionProfileUnderSteadyStateCondition • To Determine the Heat Transfer & Temperature DistributionAlong a Uniform Cross- Section Fin Under Steady State in FreeConvection. • To Determine the Heat Transfer & Temperature DistributionAlongaUniformCross-SectionFinUnderSteadyStateinForcedConvection. • ToDeterminetheSpecificHeat ofAirunderSpecifiedatmosphericConditions. • ToDeterminetheCriticalHeatFlux Through aGivenWire(NichromeWire)in aPoolBoilingProcess. • To Determine the Heat Transfer & Overall Heat TransferCoefficientinaCounterFlow&ParallelFlowHeatExchanger. • ToDeterminetheStefanBoltzmannConstantUnderGivenCondition. • ToDeterminetheEmissivityofATestPlate. • ToDeterminetheViewFactor/ShapeFactorofAGivenArrangement.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COURSEOUTCOMES: Aftercompletionofcourse,thestudentswillbeableto:

*CO1*Determine theoverallthermalconductivityofcomposite wallofaFurnace.
*CO 2*Determinethe criticalthickness ofinsulationofsteampipes ofthermalpowerplant.
*CO3*Evaluatetheeffectivenessandefficiencyofheattransfer ofFinsofmotorbikeengine.
*CO4*Determinetheheattransfereffectivenessofshellandtubeheatexchangers.
*CO5*Understandmassdiffusionrateincaseofevaporativecoolingincoolingtowers.
CO6 Understandtheeffectsoffoulingin boiler tubesofthermalpowerplant.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO1,PO2/PSO1,PSO2
CO6	PO1,PO2/PSO1,PSO2

BMEC 0005 FLUID MECHANICS

Objective: *It is major branch of mechanics. It introduces students about fluid and its difference with solids.Geometry of fluid flow can be visualized. Its importance lies in its wide ranging applications in fluid powerengineeringandmechanicsoffluidflow.Italsodiscussesvariousempiricalrelationswhicharehelpfulinboundary layerapplications.Itprovidesbasisforcomputationalfluiddynamics.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Fluid and Continuum, Physical Properties of Fluids,Rheologyof Fluids. **Dimensional Analysis and Hydraulic Similitude:** DimensionalAnalysis,Buckingham'sPiTheorem,ImportantDimensionless Numbersand Their Significance, Geometric, Kinematic and Dynamic Similarity,Model Studies. **Fluid Statics:** Pressure-Density-Height Relationship,Manometers, Pressure Transducers, Pressure on Plane and CurvedSurfaces, Centre of Pressure, Buoyancy, Stability of Immersed andFloating Bodies. **KinematicsofFluidFlow:**TypesofFluidFlows:Continuum&FreeMolecular Flows.SteadyandUnsteady,UniformandNon-Uniform,LaminarandTurbulentFlows,RotationalandIrrotationalFlows,Compressible and Incompressible Flows, Subsonic, Sonic and SupersonicFlows, Sub-Critical, Critical and Supercritical Flows, One, Two and ThreeDimensionalFlows, Streamlines,ContinuityEquationFor3Dand1DFlows,Circulation,StreamFunctionandVelocityPotential.	20
II	**Dynamics of Fluid Flow:** Euler's Equation of Motion Along A Streamlineand Its Integration, Bernoulli's Equation and Its Applications-Pitot Tube,OrificeMeter,VenturiMeterandBendMeter,NotchesandWeirs,MomentumEquationandItsApplication toPipeBends. **Laminar and Turbulent Flow:** Equation of Motion For Laminar FlowThrough Pipes, Stoke's Law, Transition From Laminar to Turbulent Flow,TypesofTurbulentFlow,MixingLengthConceptandVelocityDistributioninTurbulentFlowOverSmoothandRoughSurfaces,ResistancetoFlow,MinorLosses,PipeinSeriesandParallel,PowerTransmission ThroughAPipe,Siphon,WaterHammer. **Boundary Layer Analysis:** Boundary Layer Thickness, Boundary LayerOver A Flat Plate, Laminar Boundary Layer, Application of MomentumEquation, Turbulent Boundary Layer, Laminar Sublayer, Separation andIts Control,Drag and Lift, Drag on A Sphere, A Two Dimensional Cylinder, and An Aerofoil,Magnus Effect,Kutta-Jonkowski Theorem.	20

TextBooks:

- BansalR.K.,"*FluidMechanics*",LaxmiPublications.2016.
- Modi,P.N.,andSeth,S.H.,"*HydrualicsandFluidMachines*",StandardBookHouse,2010.
- AgarwalS.K."*FluidMechanics&Machinery*",TMH,2010.
- GuptaVijayandGuptaS.K.,"*Fluid Mechanicsand itsApplications*",WileyEasternLtd,1984.

ReferenceBooks:

- NarasimhanS., "*FirstCourseinFluid Mechanics*", UniversityPress,2012.
- Som,S.K.& BiswasG.,"*Introductionoffluid mechanics&Fluid Machines*", TMH,2000.
- DasM.M.,"*FluidMechanics&Turbomachines*",OxfordUniversityPress,2013.
- Garde,R.J.,"*Fluid MechanicsthroughProblems*", NewAgeInternationalPvt. Ltd,NewDelhi,2015.
- Shames,I.H.,"*MechanicsofFluids*",McGrawHill,Int.Student,Education,2017.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Onlearningthissubject studentswillbeableto:*

CO1:Identifyandobtainthevaluesoffluidpropertiesandrelationshipbetweenthem.
*CO2:*Understandtheprinciplesofcontinuity,momentum,andenergyasappliedtofluidmotions.
CO3:Calculatehydrostaticforceonsubmerged surfaceinastaticfluid.
CO4: Calculatebuoyancyforce tounderstandthestabilityconceptofthefloatingbody.
CO5: Applydimensionalanalysistopredictphysicalparametersthatinfluencetheflowinfluidmechanics inengineeringapplications.
CO6:Relate fundamentalsoffluidmechanicstothewidespectrumofreal lifeproblems.
CO7: Tacklereal lifeproblemsrelatedtosupplyanddistributionoffluidindomesticandindustrialsector.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2,PO3/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2,PO3/PS1
CO4	PO1,PO2,PO3/PS1
CO5	PO1,PO2,PO3/PS1
CO6	PO1,PO2,PO12/PS1
CO7	PO1,PO2,PO12/PS1

BMEC0803 FLUID MECHANICS LAB

Objective: *This lab is runin conjunctionwith thetheory course.Itis an introductory course where flowbehavior, fluidforcesandanalysistoolsareintroduced.It coversmeasuringdevicesandtechniques, erroranalysis in experimental works and analysis of assumptions in the theory of fluid mechanics. The laboratoryprovidestrainingtoundergraduateandgraduatestudentsinflowmeasurements.*

Credits:01 **L–T–P:0–0–2**

Modul eNo.	Conten t	Teachin gHour s
I	**ListofExperiments:** • ToDetermineCoefficientofDischargeofGivenShapeofOrifice. • To Determine Coefficient of Discharge of Given Shape ofVenturimeter. • ToDemonstratetheTransitionFromLaminartoTurbulentFlowand toDetermineLowerCriticalReynoldsNumber. • ToDeterminetheLossofHeadsforPipeFittings. • ToDetermineCoefficientofDischargeofGivenShapeofMouthPiece. • ToDeterminetheMetaCentricHeight oftheGiven ShipModelExperimentally. • ToDetermineCoefficient ofDischargeofAGivenShapeofV-Notch. • ToVerifyBernoulli'sTheoremExperimentally. • ToStudytheBoundaryLayerVelocityProfileOverAFlat PlateandtoDeterminetheBoundaryLayerThickness. • ToVerifyMomentumTheoremUsing MomentumTheoremApparatus. • ToDetermineCoefficientofDischargeforFlowOverARectangularWeir. • ToDeterminetheFrictionFactorforFlowThroughPipes • VirtualDemonstrationofVelocity,ViscosityandPressureMeasuring Devices.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*
Outcome: Onsuccessfulcompletionofthecourse,thestudentwillbeableto,

CO1:Enhancetheirknowledgeofbasicprinciplesoffluidmechanics.

CO2:Analyzefluidflowproblems withtheapplicationofthemomentumand energyequations.

CO3:Understandbasicworkingprinciplesofvariousflowsandpressuremeasuringequipmentslikemouthpiece,orificenotchesandweirs.

CO4:usethetechniques,skillsandmodernengineeringtoolsnecessaryforfluidengineeringpractice.

CO5:EvaluatetheMetacentricheightofsubmergedbodiestounderstandthestabilityconcept.

CO6:Estimatetheminorandmajorfrictional lossesinpipeflow.

CO7:VerifytheconceptofBernoulli'sequationinpipeflowexperimentally.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2,PO3/PS1
CO4	PO1,PO2,PO5/PS1
CO5	PO1,PO2,PO3/PS1
CO6	PO1,PO2/PS1
CO7	PO1,PO2/PS1

BMEC0006 MANUFACTURING SCIENCE – I

Pre-requisite:*Material Science*

Objective:*Toimpart thecomprehensiveinsight intovariousmanufacturingprocessessuchasmetalcasting,sheetmetal,weldingandadvancedweldingprocesses.*

Credits:03 **L–T–P:3–0–0**

Modul eNo.	Content	Teachin ghour s
I	**Introduction:**ImportanceofManufacturing,ClassificationofManufacturin g ProcessesandItsApplications. **Casting:**PatternDesign&Allowances.Gating,Riser,Runners,MoldingParametersandDesign,SolidificationofCasting,GatingSystemDesign,SandTestingMethods,CastingDefectsandRemedies.DieCasting,CentrifugalCasting,InvestmentCasting,Carbon Di-OxideCasting, **SheetmetalProcessing:**TypesofPressDie,Simple,Progressive,Compound and Combination. Punch & Die Clearance. Blanking & Piercing,CuttingandPunchingMechanism.MethodofReducingCuttingForces. Bending of Strip&SpringBack. **Welding:** Introduction and Concept of various Welding Processes, ElectricArcWeldingResistanceWelding,AtomicHydrogenWelding,GasWelding.	21
II	**Advanced Welding Processes:**Electron Beam Welding and Plasma arcWelding Process. Laser beam welding and diffusion Welding, Heat AffectedZone(HAZ)MetallurgicalAspectsofWeldJoint,WeldingDefectsandRemedies,SolidStateWeldingProcesses,FrictionWeldingProcess,ExplosiveWelding. **Metal Forming:** Metal Deformation, Yield Criteria. Concept of Inter-FacialFriction and Lubrication Mechanism in Manufacturing. Determination andCalculation of Pressure Distribution With Sliding Friction for Drawing andExtrusion of Wire/Strip, Conditions for Rolling, Force and Power in Rolling,Limiting ThicknessandReduction. **AdvancedMetalFormingProcesses:**UnconventionalMetalFormingProcesses- Explosive Forming, Electromagnetic Forming, Electro-HydraulicForming,Hydro-StaticExtrusion,Hydro-DynamicWire Drawing,ConceptandApplicationsofPowderMetallurgy.	21

RecommendedBooks:

- Sharma P.C.,“*ManfacturingEngineering*”,S.ChandNewDelhi
- GrooverM.P., “*ManufacturingProcess:MaterialsofSystems*”,John Wiley&Sons,Inc.
- Serope**Kalpakjian,**“*ManufacturingProcess*”,AddisonWesleyPublishingCo.
- GhoshandMalik,“*Manufacturingscience*”,EastWestPvt.Ltd.
- Boothroyd, “*FundamentalofMetalCutting and MachineTools*”, John Wiley& Sons,Inc.
- OstwaldPhillipF.,“*ManufacturingProcess*”,JohnWiley&Sons,Inc.

- DeGarmo,"*Materials&Manufacturing*",WileyPublications.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:

Students areexpectedtolearn:

Oncompletionofthiscourse,thestudents wouldbeableto:

CO1.Thestudentwillbehavingthecapability ofselectingsuitablemanufacturingprocessestomanufacturetheproductsoptimally.

CO2.Thestudent willabletounderstandthevariousmetalcasting methods,designingofriserandgatingsystemalongwithcastingdefectsandtheiranalysis.

CO3.Thestudentwillbeabletorecommendtheappropriatedesignofgatingsystems,formingprocesses,Sheetmetaloperations.

CO4.Thestudentwillabletounderstandthetypesofweldingaccordingto materialsapplicationandvariousadvancedweldingmethodandthererequirementsandNDTtechniques.

CO5.Thestudentwillabletounderstandtheprocessingof variousconventionalandadvancedmetalformingprocessesandparameters.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos) andProgramOutcomes(PSOs):

CO	**POs/PSOs**
CO1	PO1,PSO2
CO2	PO3,PSO2
CO3	PO3,PSO2
CO4	PO1,PSO2
CO5	PO1,PSO2,PSO3

BMEC0804: MANUFACTURING SCIENCE - ILAB

Objective: *The purpose of this lab is to enable the students to have the practical skills for basic manufacturingoperations e.g. Preparation of Sand, Making Pattern with allowances, Preparation of different types of mouldswith cores for various castings. The student will also have practical exposure to Press work and die assembly andmachining processes on various machine tools such as Spur gear on milling machine, knurling Bush on CapstanLatheandpreparationofSinglepointcuttingtoolonToolGrindingmachine.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**ListofExperiments-** • ToStudyand AnalyzeDifferent TypesofPatternsConsidering: (A) Shape(B) Size(C) PartingLine • ToDesignandFabricatethePatternforAGivenComponentConsideri ng Different Allowances and Surfaces Which RequireMachining. • To Make A Casting for Half Bush Gland By SelfHanging CoreMouldasPerGivenDimensions. • To Make A Casting for Hollow Step Pulley With the Help of GreenSandMould. • ToPreparetheBushGlandFromMetalByUseofDiesCastingMethod. • ToPrepareABarofCircularCrossSectionFromSquareBarKeep ing LengthConstant. • ToPreparetheRing ByUsing theBending andForgeWeldingOperation. • ToMakeaWasherbyUsing Combination DieandtoStudyHowProgressiveDieisDifferentfromCombination Die. • ToAnalyzetheFlowPatternDuringTubeBendingProcess. • To Analyze the Flow Pattern and Die Load During DirectExtension Process By Using Dies of Different Shapes and CrossSectionDuring: (A) DifferentReductionRatio(B)DifferentShapes • ToMakeA 10T.P.I.(R.H.) Thread on M.S.BarforHexagonalBoltWiththeHelp ofCentreLatheMachineas PerGivenFigure. • To Make A Cast Iron Block and Make A Key Way on Its SurfaceWiththeHelp ofShaperMachineas PerGivenFigure. • ToMakeAPlain(Spur)Gearof10TeethonMillingMachineasPerGi venFigure. • ToMakeAKnurling Bushon CapstanLatheasPerGivenDimensions andSketch. • ToMakeASinglePoint CuttingToolAnglesWiththeHelpofToolGrindingMachineA PerGivenDimensions and Sketch.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *On successful completion of this lab, the students will be able to:CO1:Demonstrateanunderstandingofandcomplywith FoundryShop; CO2:Abletousetoolsformouldpreparation,coresformanufacturingthecastingobjects;CO3:Identifythedefectsproducedincastings; CO4:Abletogaintheknowledgeofbasicoperationof HandForging;CO5: Able to perform the basic operations of Hand press machine;CO5:Abletoperform theoperationson LatheMachineTool; CO6:Abletogaintheoperationalknowledgeof ShaperandMillingMachineTool.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO3,PSO3
CO2	PO1
CO3	PO1
CO4	PO1,PO3
CO5	PO1
CO6	PO1,PO3,PSO3

BMEC0007STRENGTHOF MATERIALS

Pre-requisite: *Applied Mechanics*

Credits:03 L–T–P:3–0–0

Module No.	Content	Teaching Hours
I	**Stress and Strain:** Simplestress, typesof stressesand strains, hook'slaw,principle of superposition, Elastic constants, bars of varying section, uniformlytaperedbars,elongationofbarduetoself-weight,compoundbars,Indeterminatestructures,Thermalstressesinuniformbars .Strainenergy,impactloading. **Simple Bending of Beams:** Theory and assumptions of Pure Bending, Stressesin Beams Under Different Types of Loads, Beam of uniform strength, Directshearstressesin beams. **Torsion:** Torsion of Circular shafts, design of shaft, stress and strain in pureshear,Staticallyindeterminatetorsionalmember,strainenergyintorsion. **Slope and Deflection of Beams:** Slope and Deflection of Statically DeterminateBeamsUsingMacaulay'sMethod,Area-Moment andCastigliano'sTheorem.	22
II	**Compoundstressandstrain:**Introduction,planestress,principleplanes,principle stresses and maximum shear stresses, Mohr's circle for plane stress,hook's law for plane stress, tri-axial stress, transformation equations for planestress, plane strain. **Theories of Elastic failures:** Rankine's theory, St. Venenttheory,Guest'stheory,Haigh'stheory,Maximumdistortionenergytheory,graphicalrepresentationandtheircomparison. **Columns:** Euler's Theory of Buckling of A Column, Middle-Third and Middle-Quarter Rules, End Conditions For Columns, Different Empirical Formulae ForColumns. **PressureVessels:**StressesandStrainsinThinandThickCylindersandSpheresSubjected toInternalandExternalPressures. **Springs:**DeflectionofHelicalSprings(opencoilandclosedcoil)UnderDifferentTypesofLoads,Springs inSeriesand Parallel,LeafSprings.	24

TextBook

- L.S.Shrinath, "MechanicsofSolids":TataMcGraw-HillPublication,2009.
- B.J.Goodno andJ.M. Gere,"Mechanicsof materials, 9e":CenageLearning,2018.
- B.C.Punamia, A.K.JainandA.K.Jain, "Mechanicsofmaterials": LaxmiPublication,2017.
- R.K.Rajput,"ATextbookof StrengthofMaterials(MechanicsofSolids)inSIUnits7e":SChand,2018.

ReferenceBooks:

- G.H.Ryder,"StrengthofMaterials":MacmillanPublishersIndiaLimited,2002.
- S. P. Timoshenko and D. H. Young, "Elements of Strength of Materials": Affiliated East-West Press,2003.
- F.P.Beer and E.R.Johnston, "MechanicsofMaterials(SIE)7e":McGrawHillEducationIndiaPrivate
- Limited,2017.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

CO1:Understandtheconceptsofstressandstrainatapointaswellasthestress-strainrelationshipsforhomogenous,isotropicmaterialsandclassifythetheoriesof failureforstatic loading.
CO2:Calculatethestressesandstrainsinaxialloading,bendingofbars,circulartorsionmembers,andmemberssubjecttoflexuralloadingsandmemberssubjected tocombined loading.
CO3:DrawShearForceandBendingMomentdiagramsofvarioustypesofbeamssubjectedtodifferentloads.
CO4:Determinetheslopeanddeflectionsproducedbythethreefundamentaltypesofloads:axial,torsional,andflexural.
CO5:Computeandillustratetheprincipalstresses,maximumshearingstress,andthestressesactingonastructuralmember.
CO6:Calculatethestressesandstrainsassociatedwiththin-wallsphericalandcylindricalpressurevessels.
CO7:Understandthephenomenonofbucklingofcolumnsandcalculatethecriticalloadforslender,longcolumnssubjectedtoaxial loads.

MappingofCourseOutcomes(COs)withProgram outcomes(POs)andProgram SpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO3,PO4/PSO3
CO5	PO2,PO3/PSO3
CO6	PO2,PO3,PO4/PSO3
CO7	PO2,PO3/PSO3

BMEC0008 KINEMATICS OF MACHINES

Pre-requisite:AppliedMechanics

Objective:Toexplainvariousgoverninglawstounderstandmechanism,todevelopmachinesbasedonsimplemechanismandu nderstandforcesinvolved.Tounderstanddifferenttypesofgearsbasedonlinkmechanisms

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:**Definitions:Link,kinematicpairs,kinematicchain,mechanism,structure,degrees of freedom, Classification links, Classifiction of pairs based on type ofrelativemotion,Grubler\'scriterion,mobilityofmechanism,Groshoff'scriteria,inversionsofFourBar ,SingleSliderandDouble SliderCrank. **SPECIAL MECHANISMS:** Exact Straight Line Motion Mechanisms - Peaucellier's, Hart andScottRussellMechanisms,ApproximateStraightLineMotionMechanisms–Grass-Hopper, Watt and Tchebicheff Mechanisms, Pantograph, Condition for correct steering,DavisandAckermansteeringgearmechanism. **Velocity and Acceleration Analysis of Mechanisms:** Velocity and acceleration analysisofFourBarmechanism,slidercrankmechanismandSimpleMechanismsbyvectorpolygons:Relativevelocityandaccelerationofparticles.inacommonlink,relativevelocity and accelerations on separate links- Coriolis component of acceleration. Angularvelocityandangularaccelerationoflinks,velocityofrubbing.	22
II	**Velocity Analysis by Instantaneous Center Method Klein's Construction:**VelocityAnalysisbyInstantaneousCenterMethod:Definition,Kennedy'sTheorem,Determination of linear and angular velocity using instantaneous center method Klein'sConstruction:Analysisofvelocityandaccelerationofsingleslidercrankmechanism. **SpurGears**:Gearterminology,lawofgearing,pathofcontact,arcofcontact,contactratio of spur gear. Interference in involute gears, methods of avoiding interference, forminimum number of teeth to avoid interference, Simple gear trains, compoundgeartrains. Epicyclic gear trains: Algebraic and tabular methods of finding velocity ratio ofepicyclic gear trains, torque calculation in epicyclic gear trains.**Cams:** Types of cams, types of followers. displacement, velocity and acceleration curvesvelocity, Simple Harmonic Motion, Uniform Acceleration Retardation, Cycloidalmotion.Camprofiles:disccamwithreciprocating/oscillatingfollowerhaving,roller andflat-facefollowerinline.	18

TextBooks:

- S.S.Ratan,"TheoryofMachines5e":TataMcGraw-HillPublication,2019.
- J.K. GuptaandR.S. Khurmi, "TheoryofMachines14e":SChand& CoLtd,2005.
- R.K. Bansal and J. S.Brar,"ATextbookofTheoryofMachines5e":LaxmiPublishers, 2016.

ReferenceBooks:

- J. J. Uicker, G. R. Pennock and J. E. Shigley, "Theory of Machines and Mechanisms": Oxford

UniversityPress,2014.

- A.GhoshandA.K. Mallik,“TheoryofMachinesandMechanisms”:Eastwestpress,2008.
- P.L.Ballaney,“Theoryofmachines &Mechanism”: JohnWileyPublishers,2005.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:*Afterstudyingthissubjectstudentswillbeableto:*
CO1:Compute the forces and torques involved in friction drives like screw threads, clutches, belts, ropes and band and block brakes.
CO2:Design a possible gear train and determine the speeds of simple, compound and epicyclic gear trains.
CO3:Sketch slow speed and high speed cam profile for the required predefined motion of follower.
CO4: Analyze velocity and acceleration of mechanisms.
CO5:Calculate kinematic properties of simple planar mechanisms using graphical approach, instantaneous center method and synthesis them at elementary level.
CO6:Model planar mechanisms which will have defined required motion.

MappingofCourseOutcomes(COs)withProgram outcomes(POs)andProgram SpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO3/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO2/PSO3
CO5	PO2,PO3/PSO3
CO6	PO2,PO3/PSO3

BMEC0009: DYNAMICS OF MACHINES

Pre-requisite: *KinematicsofMachine*
Objective: *The objective of this course is to provide the details of the concepts of generalized forces and Staticand dynamic force analysis, concepts of static and dynamic mass balancing. To introduce the approaches andmathematical models used dynamical analysis of machinery. To teach students concepts of free Vibration ofSingle Degree ofFreedomSystems,VibrationMeasurementandApplications, Modal Analysis.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Static and Dynamic Force Analysis:** Static equilibrium. Equilibrium of twoand three force members. Members with two forces and torque. Free bodydiagrams. Static force analysis of four bar mechanism. Dynamic force analysisofSlider Crankmechanism. **TurningMoment&Flywheel:**TurningMomentonCrankshaft,TurningMoment Diagrams- Four Stroke IC Engine and Multi-Cylinder Steam Engine,FluctuationofEnergy,Flywheel. **BalancingofRotatingandReciprocatingMasses:**StaticandDynamicBalancing, Balancing of Several Masses in the Same Plane and Different Planes,BalancingofReciprocatingMasses,BalancingofPrimaryForceinReciprocatingEngine,PartialBalancingofTwoCylinderLocomotives,Variationof TractiveForce,SwayingCouple,HammerBlow. **Governors:** Terminology, Centrifugal Governors-Watt Governor, Dead WeightGovernors-Porter&ProellGovernor,SpringControlledGovernor-HartnellGovernor,Sensitivity,Stability,Hunting,Isochronism,EffortandPowerof Governor,ControllingForceDiagramsforPorterGovernorandSpringControlledGovernors.	20
II	**Friction:**PivotsandCollarFriction-UniformPressureandUniformWear,Frictional, Centrifugal Clutches,Belt and Pulley Drive, Length of Open andCrossBeltDrive,Ratio ofDrivingTensionsfor FlatBeltDrive,CentrifugalTension, ConditionforMaximumPowerTransmission,V BeltDrive. **Gyroscopic Motion:** Gyroscopic Torque, Effect of Gyroscopic Couple on theStabilityofTwo WheelerandFourWheeler, Ships andAero-Planes. **MechanicalVibrations:**TypesofVibrations,DegreesofFreedom,Single Degree Free & Damped Vibrations, Forced Vibration of Single Degree SystemUnderHarmonicExcitation, Critical SpeedsofShaft.	20

TextBooks:

- RattanS.S.,“TheoryofMachines”,TMH.
- BallaneyP.L.,“TheoryofMachines”,KhannaPublication.
- Khurmi&Gupta,“TheoryofMachines”, S.ChandandCompanyLtd.,.NewDelhi.

- BansalR.K.,“TheoryofMachines”,LaxmiPublishers.
- SinghV.P.&ChandS.,“TheoryofMachines”,DhanpatRai&Sons.

ReferenceBooks:

- BevanThomas,“TheoryofMachines”,CBSPublishersandDistributors.
- Shingle,“TheoryofMachinesandMechanisms”,McGraw–HillInternationalEditions.
- Ghosh&Mallik,“TheoryofMachinesandMechanisms”,Eastwestpress.
- Rao&Dukkipati,“TheoryofMachinesandMechanisms”,Eastwestpress.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletingthis coursethestudentwillbeableto:

CO 1: Take notice of importance of the balancing and learn procedures of the static anddynamicbalancing.
CO2:Understandtheimplicationsofcomputedresultsindynamicstoimprovethedesignofa mechanism.
CO3:Understandtheconceptofwhirlingofshaft,effectofgyroscopiccoupleonaeroplane.
CO4:Practicallyknowhowthegovernorapparatusworks.
CO 5: Determine the natural frequencies of continuous systems starting from the generalEquationof displacement.
CO6:Understandthevarioustypesofvibratorymotions.

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)andProgrammeSpecific Outcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1
CO2	PO1,PO2,PO3,PO4/PSO1,PSO3
CO3	PO1,PO2,PO4/PSO3
CO4	PO1,PO6,PO8/PSO3
CO5	PO1,PO2,Po3,PO9/PSO1
CO6	PO1,PO2,PO4,PO12/PSO1

BMEC0805: THEORY OF MACHINES LAB

Objective: *ObjectivesofthisTheoryofMachineslabaretoimpartpracticalknowledgeondesignandanalysisof mechanisms for the specified type of motion in a machine. With the study of rigid bodies motions and forces forthe transmission systems, machinekinematics and dynamics canbe wellunderstood. Demonstration exercisesare provided with wide varieties of transmission element models to understand machine kinematics. Variousexperiments with governors, gyroscopes, balancing machines and universal vibration facilities are available tounderstandmachinedynamics.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments • StudyofSimpleLinkageModels/MechanismsandVerificationofGrashoff'sCriteria ofFour BarLinkages. • DeterminationofVelocityRatioandVerificationofHoldingtorqueinEpicyclicGearTrains. • DeterminationofNaturalFrequencyinLongitudinalVibratingSystem. • DeterminationofNaturalFrequencyinTransverseVibrationSystem. • ExperimentalinvestigationoftheCharacteristicsofDeadWeightMechanicalGovernor. • ExperimentalinvestigationoftheCharacteristicsofSpringControlledGovernor. • DeterminationofCriticalSpeedinWhirlingofShafts. • Study of the Principles of Gyroscope and Verification of the EquationofGyroscopicCouple. • StudyoftheConceptofStatics&DynamicBalancingofRotatingMassesinSingleandMultiPlanesandVerificationofBalancingPrinciples. • Measurement of Slip in Flat Belt under Different Belt Tensions andVaryingLoadConditions.	

TextBooks:

- S.S.Ratan,"TheoryofMachines",TMH
- Khurmi&Gupta,"TheoryofMachines",S.ChandandCompanyLtd.,.NewDelhi.
- BansalR.K.,"TheoryofMachines",LaxmiPublishers.
- SinghV.P.&ChandS.,"TheoryofMachines",DhanpatRai&Sons.

ReferenceBooks:

- Shingle,"TheoryofMachinesandMechanisms",McGraw–HillInternationalEditions.
- Ghosh&Mallik,"TheoryofMachinesandMechanisms",Eastwestpress.
- Rao&Dukkipati,"TheoryofMachinesandMechanisms",Eastwestpress.
- Balani,"Theoryofmachines &Mechanism",JohnWileyPublishers.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletingthis coursethestudentwillbeableto:

CO1:Understandtheconceptofwhirlingofshaft,effectofgyroscopiccoupleonaeroplane.

CO2:Analyzethedifferenttypesofmechanisminvolvedinthemachines.

CO3:Gatherknowledgeabouttheslipandcreepphenomena occurringinbeltdrives.

CO4:Practicallyknowhowthegovernorapparatusworks.

CO5:knowtheconditionofStaticanddynamicbalancing.

CO6:understandthevarioustypesofvibratorymotions.

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)andProgrammeSpecific Outcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO3
CO2	PO1,PO2,PO9/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO6,PO8/PSO1
CO5	PO1,PO2/PSO1
CO6	PO1,PO2,PO12/PSO3

BMEC0010: MACHINE DESIGN – I

Pre-requisite: *StrengthofMaterials*
Objective: *Theobjectiveofthiscourseistointroducedesignconceptsandproceduresnecessarytodesignandselectama chinecomponent intermsofgeometryandmaterials,subjectedtostaticand/ordynamicload.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Mechanical Engineering Design,Design considerations, Standards inDesign,Material Selection. **Design Against Static Load:** Modes of Failure, Factor of Safety, Theories of Failure.**Design Against Fluctuating Loads:** Cyclic Stresses, Fatigue and Endurance Limit,Stress Concentration Factor, Design for Finite and Infinite Life, Soderberg, GoodmanCriteria. **Shafts:** Cause of Failure in Shafts, Materials for Shaft, Design of Shafts, Shafts SubjectedtoFatigue Loads. **Keys and Couplings:** Types of Keys, Splines, Design of Square & Flat Keys, Couplings-Designof RigidandFlexible Couplings.	20
I	**DesignofRivetedJoints:**TypesofRivetedJoints,FailureofRivetedJoint,EfficiencyofRivete d Joint,Designof BoilerJoints,EccentricLoadedRiveted Joint. **Design of Threaded Joint:** Design of Bolted Joint, Eccentrically Loaded Bolted Joint.**DesignofWeldedJoints-**StressesinButtandFilletWelds,EccentricallyLoadedJoint. **MechanicalSprings:**Materialfor HelicalSprings,Designof HelicalSpringsSubjectedtoStaticandFatigueLoading,Design ofLeafSpring. **PowerScrews:**FormsofThreads,MultipleThreads,EfficiencyofSquareThreads,Trapezoid alThreads,StressesinScrews,Designof ScrewJack. **Note:DesignDataBookIsAllowedin theExamination**	20

TextBooks:

- SharmaandAgrawal,"*MachineDesign*",S.K.Katara&Sons.
- BhandariV.B.,"*DesignofMachineElements*",TataMcGrawHillCo.
- ShigelyJosephE.,"*MechanicalEngineeringDesign*",McGrawHillPublications.

ReferenceBooks:

- ValanceAlexandDoughtieVI,"*DesignofMachineMembers*",McGrawHillCo.
- SpottM.F.,"*Machinedesign*",PrenticeHallIndia.
- MaleevandHartman,"*MachineDesign*",CBSPublications.
- Black&Adams,"*Machinedesign*",McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Attheendofthecourse,astudentwillbeableto*

CO1:Analyzethestressesinmachineelementsandstructuralmembersundervariousloads.
CO2:Applymultidimensionalfailurecriteriaintheanalysisanddesignofmachinecomponents.
CO3:Understandthecausesofstructuraljointsfailures.
CO4:Designandselectionofstructuralriveted,boltedandweldedjoints.
CO5:Designanddeterminethefatiguelifeofcircularshaftsunderthecombinedloadings.
CO6:Selectionofmechanicalkeys.
CO7:Designofrigid&flexiblecouplings.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1, PO2/PSO1
CO2	PO3, PO4/PSO1
CO3	PO1,PO2,PO3/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO2,PO3/PSO1
CO6	PO1,PO2,PO3/PSO1
CO7	PO1,PO2,PO3/PSO1

BMEC0806: MACHINE DESIGN – I LAB

Objective:*The primary objective of this course is to demonstrate how engineering design uses the manyprinciples learned in previous engineering science courses and to show how these principles are practicallyapplied Estimate fatigue strengths of steel parts. Applytechniques of combined stress and Mohr's circle inmachine designsituations.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments **StudentsareAdvisedtoUseDesignDataBookFortheDesign.Drawing Shall be Made Wherever Necessary (Using CAD-SoftwareSuchasAutoCAD).** • Design&DrawingofCotterJoint. • Design&DrawingofKnuckleJoint. • DesignofMachineComponentsSubjectedtoCombinedSteadyandVariableLoads. • Design&DrawingofEccentricallyLoadedRivetedJoint. • Design&DrawingofBoiler RivetedJoint. • DesignofShaftforCombinedConstantTwistingandBendingLoads. • DesignofShaftSubjectedtoFluctuatingLoads. • Design&DrawingofFlangedTypeRigidCoupling. • Design&DrawingofFlexibleCoupling. • DesignofHelicalSpring. • DesignofLeafSpring. • DesignofHelicalSpringSubjectedtoFluctuatingLoad. • DesignofScrewJack. • DesignofEccentricallyLoadedWeldedJoint. • DesignofEccentricallyLoadedThreadedJoint.	

TextBooks:

- SharmaandAgrawal,"*MachineDesign*",S.K.Katara&Sons.
- BhandariV.B.,"*DesignofMachineElements*",TataMcGrawHillCo.
- ShigelyJosephE.,"*MechanicalEngineeringDesign*",McGrawHillPublications.

ReferenceBooks:

- ValanceAlexandDoughtieVI,"*DesignofMachineMembers*",McGrawHillCo.
- SpottM.F.,"*Machinedesign*",PrenticeHallIndia.
- MaleevandHartman,"*MachineDesign*",CBSPublications.
- Black&Adams,"*Machinedesign*",McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*At theend ofthecourse,a studentwill beable to*

- *CO1:Understandtheconceptsofgeometricandsolidmodelling.*

- *CO2:DesignofMachineComponentsSubjectedtoCombinedSteadyandVariableLoads.*
- *CO3: Model and simulate the mechanical engineering parts and components which includeCotter Joint, Knuckle Joint, structural joints, shaft, spring & screw jack along with theirassemblyinaCAD package.*
- *CO4:Studentswillbeabletoidentifyandanalyzepracticalproblems.*

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1, PO5/PSO1
CO2	PO2, PO3/PSO1
CO3	PO3, PO5/PSO1
CO4	PO3, PO5/PSO1

BMEC0011: MACHINE DESIGN II

Pre-requisite: *MachineDesignI*
Objective: *The objective of this course is to introduce the guidelines for design of bearings, gears, to know thedesign process of different IC engine parts like cylinder head, piston, gudgeonpin, connecting rod, crank shaftetc.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**SpurGears:**ToothForms,StandardProportionsofGearSystems,Interference,SelectionofGearMaterials,BeamStrengthofGearTooth,DynamicToothLoad,WearStrengthofGear Tooth,Failure ofGearTooth,Designof SpurGears,AGMAandIndianStandards. **Helical Gears:** Beam Strength and Wear Strength of Helical Gears, Design ofHelicalGears. **BevelGears:**StressesinBevelGears,DesignofBevelGears. **Worm Gears:** Efficiency of Worm Gears, Heat Dissipation in Worm Gearing,Strengthand WearToothLoadforWorm Gears, DesignofWorm Gearing.	18
II	**Sliding Contact Bearing:** Selection of Bearing, Hydrodynamic Lubrication,Properties and Materials, Lubricants and Lubrication, Hydrodynamic JournalBearing, Design of Journal Bearing, Thrust Bearing-Pivot and Collar Bearing,Hydrodynamic ThrustBearing. **Rolling Contact Bearing:** Classification, Bearing Life, Reliability of Bearing,SelectionofRolling Contact Bearing,Lubrication,MountingofBearing. **ICEngineParts:**SelectionofICEngine,DesignConsiderations,Designof Cylinder and Cylinder Head; Design of Piston, Piston Ring and Gudgeon Pin;Designof ConnectingRod;Design ofCrankshafts.	22

TextBooks:

- SharmaandAgrawal,"*MachineDesign*",S.K.Katara&Sons.
- Bhandari,V.B.,"*DesignofMachineElements*",TataMcGrawHillCo.

ReferenceBooks:

- Shigely,JosephE.,"*MechanicalEngineeringDesign*",McGrawHillPublications.
- Valance,AlexandDoughtie,VI,"*DesignofMachineMembers*",McGrawHillCo.
- Spott,M.F.,"*MachineDesign*",PrenticeHallIndia.
- MaleevandHartman,"*MachineDesign*",CBSPublications.
- Black&Adams,"*MachineDesign*",McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Attheendofthecourse,astudentwillbeableto

- *CO1:UnderstandthegeartoothsystemasperAGMAstandardsSpurGear,Helicalgear,BevelGear&wormgears.*
- *CO2:AnalyzetheforceactingonSpurGear,Helicalgear,BevelGear&wormgearsusedinpowertransmissionapplications.*
- *CO3:SelectthematerialandevaluateofstressesforSpurGear,Helicalgear,BevelGear&wormgearsu*

sed inpowertransmissionapplications.

- *CO4:DesignandselectionofSpurGear,Helicalgear,BevelGear&wormgearsusingAGMAstandards andcatalogues.*
- *CO5:Understandthecausesofbearingfailures.*
- *CO6:Understandtheselectionofhydrodynamic,hydrostaticandrollingelementbearingsusedfor powertransmissionshafts.*
- *CO7:Designofhydrodynamic,hydrostaticandrollingelementbearingsusedforpowertransmissions hafts.*
- *CO8:Designcylinder,piston,connecting-rodandcrankshaftsusedinICengines.*

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1, PO3/PSO1
CO3	PO1, PO3/PSO1
CO4	PO1,PO6,PO8/PSO1
CO5	PO2,PO3, PO4/PSO1
CO6	PO1, PO3/PSO1
CO7	PO1,PO2,PO3/PSO1
CO8	PO1,PO2,PO3/PSO1

BMEC0807: MACHINE DESIGN - II LAB

Objective: *Develop and evaluate alternatives for mechanical systems. Learn programming of design problems.Apply iterative techniques in design, including making estimate of unknown values for first computation andchecking or revising and re-computing. Design Gears, Bearings and IC engine. Learn Modeling and Analysis onSoftware.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	• DesignofSpurGear • DesignofHelicalGear • DesignofBevelGear • DesignofWormandWormGear • DesignofGearAssembly • DesignofProjectReportConsistsofDifferentTypesofGears • DesignofAntifrictionBearingAssembly • DesignofJournalBearing • DesignofProjectReportConsistsofDifferentTypesofBearings. • DesignofCylinderandCylinderHead. • DesignofPiston,PistonRingandGudgeonPin. • DesignofConnectingRod. • DesignofCrankshafts. • The Design Project Consists of Two Imperial Size Sheets Drawn With3D/2D CAD Software- One Involving Assembly Drawing With A PartList and Overall Dimensions and the Other Sheet Involving Drawingsof Individual Components, Manufacturing Tolerances, Surface FinishSymbols and Geometric Tolerances Should be Specified So as to MakeItWorkingDrawing.ADesignReportGivingAllNecessaryCalculations of the Design of Components and Assembly Should BeSubmitted. Students Are Required to be Submitted A Design Report Giving All NecessaryCalculationsofthe Designof ComponentsandAssembly. DevelopthePrograms in 'C'LanguageforAllDesignComponents.	

TextBooks:

- SharmaandAgrawal,"*MachineDesign*",S.K.Katara&Sons.
- Bhandari,V.B.,"*DesignofMachineElements*",TataMcGrawHillCo.

ReferenceBooks:

- Shigely,JosephE.,"*MechanicalEngineeringDesign*",McGrawHillPublications.
- Valance,AlexandDoughtie,VI,"*DesignofMachineMembers*",McGrawHillCo.
- Spott,M.F.,"*MachineDesign*",PrenticeHallIndia.
- MaleevandHartman,"*MachineDesign*",CBSPublications.
- Black&Adams,"*MachineDesign*",McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Attheendofthecourse,astudentwillbeableto*

- *CO1:DeveloptheProgramsinMatLABLanguageforthedesignofmachinecomponentswhichinclude Gears, Bearings andI.C. enginecomponents.*
- *CO2:ModelandsimulateGears,BearingsandI.C.Enginecomponentsusedinpowertransmissionapplicationswiththeirassemblyina CADpackage.*
- *CO3:DesignandselectionofSpur,Helical,BevelandWormGears.*
- *CO4:Designofhydrodynamic,hydrostaticandrollingelementbearingsusedforpowertransmissionshafts.*
- *CO5:Designcylinder,piston,connecting-rodandcrankshaftsusedinICengines.*

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO5/PSO1
CO2	PO2, PO5/PSO1
CO3	PO1, PO3/PSO1
CO4	PO1,PO3/PSO1
CO5	PO1,PO3/PSO1

BMEC0012: FLUID MACHINERY

Pre-requisite:*FluidMechanics*

Objective:*Tounderstandbasicconceptof HydraulicTurbines,ReciprocatingPumpsandCentrifugal Pumpsandit'sapplicationtohydropowergeneration.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Classification of Fluid Machines & Devices, Application ofMomentumandMomentum,EquationtoFlowThroughHydraulicMachinery,Euler'sFundamentalEquation. **Impact of Jet:** Introduction to Hydrodynamic Thrust of Jet on A Fixedand Moving Surface (Flat *&* *C*urve), Effect of Inclination of Jet With theSurface. **HydraulicTurbines:**ClassificationofTurbines,ImpulseTurbines,ConstructionalDetails,VelocityTriangles,PowerandEfficiencyCalculations. **ReactionTurbines:**FrancisandKaplanTurbines,ConstructionalDetails, Velocity Triangles, Power and Efficiency Calculations, Degree ofReaction, Draft Tube, Cavitations in Turbines, Principles of Similarity,UnitandSpecific Speed, Performance Characteristics, Selection of Water Turbines, Governing ofTurbines.	20
II	**CentrifugalPumps:**ClassificationsofCentrifugalPumps,VectorDiagram, WorkDonebyImpellor,EfficienciesofCentrifugalPumps,SpecificSpeed,ModelTesting,Cavitations&SeparationandTheirControl,PerformanceCharacteristics. **Positive Displacement Pumps:** Reciprocating Pump Theory, Slip andCoefficient of Discharges, Indicator Diagram, Effect and Acceleration,WorkSavedbyFittingAirVessels,ComparisonofCentrifugalandReciprocatingPumps,PositiveRotaryPumps,GearPumpandVanePump, PerformanceCharacteristics. **HydraulicSystem:**HydraulicAccumulator,SpecialDutyPumps,Intensifier,HydraulicPress,LiftandCranes,TheoryofHydraulicCoupling and Torque Converters, Hydraulic Ram, Jet Pumps, Air LiftPumps.	20

TextBooks:

- Lal,Jagdish,"*HydraulicMachines*",MetropolitanBookCo.Pvt.Ltd.,2016
- Rajput, RK, "*HydraulicMachines*", S.Chand&coLtd.,2016
- Kumar,D.S.,"*HydraulicMachines*",KhannaPublishers,2010

ReferenceBooks:

- Vasandhani,V.P.,"*HydraulicMachines:Theory&Design*",KhannaPublishers,2019
- Addison,Thomas,"*AppliedHydraulics*",CBSPublishers,2003
- Philip, Gerhart and Wright Terry, "Fluid Machinery- application Selection and Design", CRSPublishers,2009

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Onlearningthissubject studentswillbeableto:*

CO1:Analyzetheforcesexerted byajetoffluid onfixed and movingvanes.
CO2:Evaluatetheperformanceofmiscellaneoushydraulic machineshydraulicRam,press,intensifier
CO3:AnalyzetheconstructionfeaturesandworkingprinciplesofPeltonTurbine,FrancisTurbineandKaplanT urbine.
CO4:AnalyzetheconstructionfeaturesandworkingprinciplesofCentrifugaland Reciprocatingpump.
CO5:Estimationofhydropowerpotentialandefficiencyof FrancisTurbineandKaplanTurbine.
CO6:AnalyzetheperformancecharacteristiccurvesofFrancisTurbineandKaplanTurbine.
CO7:Designandanalysisofdraft tubesusedinreactionturbines.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**PO's/PSO's**
CO1	PO1,PO2,PO3/PSO1
CO2	PO1,PO2,PO6/PSO1
CO3	PO1,PO2,PO3/PSO1
CO4	PO1,PO2,PO12/PSO1
CO5	PO1,PO2,PO3/PSO1
CO6	PO1,PO2,PO3/PSO1
CO7	PO1,PO2,PO3/PSO1

BMEC0808 FLUID MACHINERY LAB

Objective: *Tounderstandbasicconceptof HydraulicTurbines,ReciprocatingPumpsandCentrifugal Pumpsanditsapplicationtohydropowergeneration.*

Credits:01 **SemesterVI** **L–T –P:0–0–2**

Module No.	Content	Teaching Hours
1	**ListofExperiments:** • DemonstrationofWorkingPrincipleoftheRunnerofPeltonWheel,Francis TurbineandKaplanTurbine. • ToFindEfficiencyandPerformanceCharacteristicsCurveofPelton Turbine. • ToFindEfficiencyandPerformanceCharacteristicsCurveofFrancis Turbine. • ToFindEfficiencyandPerformanceCharacteristicsCurveofKaplan Turbine. • ToFindthePerformanceCharacteristicsofACentrifugalPumpand ToFindItsSpecificSpeedandEfficiency. • ToFindthePerformanceCharacteristicsofAReciprocatingPump andtoFindtheSlip. • ToVerifyMomentumEquationExperimentallyThroughImpactofJetExperiment. • ToDeterminetheEfficiency ofHydraulicRam. • DemonstrationofAnyWaterPumpingStation/PlantThroughDetailedVisit. • DemonstrationofWorkingModelofHydraulicLift. • DemonstrationofWorkingModelofHydraulicBrake. • ToDesigntheImpellerofCentrifugalPumpUsingSingleArcMethodThroughAutoCad. • ToDesigntheCasingofImpeller PumpThroughAutoCad. • ToInvestigatethePerformanceofAGearPumpand toPlottheCharacteristics.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Onlearningthissubject studentswillbeableto:*

CO1:Selectahydroturbine(Peltonwheel, Francisturbine,Kaplanturbine)orapumponthebasicofavailableheadanddischarge.
CO2: Determinetheforceexerted byajetoffluidonfixedand movingvanes
CO3:Calculatevariousparameterslikeworkdone,efficiency,workingproportions,specificspeedofvarioustur bines.
CO4:Gainknowledgeaboutthedesignmethodologiesofvariouscomponentsofhydroturbineandpumps.
CO5:Conductexperimentsforagivenpurposeandtoanalyzeexperimentaldataanddevelopempiricalequations.
CO6:Understandtheworkingofhydraulicram,hydraulicbrake,torqueconverterandhydrauliclift.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2,PO3/PSO1
CO4	PO1,PO2,PO12/PSO1
CO5	PO1,PO2,PO12/PSO1
CO6	PO1,PO2/PSO1

BMEC0013 MANUFACTURING SCIENCE – II

Pre-requisite: *ManufacturingScienceI*

Objective: *In this course students acquire the ability to formulate problems in Traditional and advanced metalcuttingandevaluatethecuttingparameters,establishacompletesolutiontometalcuttingproblemsusingmathematicalor graphicaltechniques.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Machining:** Mechanics of Metal Cutting. Geometry of Tool and Nomenclature, ASASystem, Mechanics of Chip Formation, Types of Chips. Merchant's Circle Analysis,CuttingForces,PowerRequired,ToolMaterial,ToolWearandToolLife,Machinability,Economicsofmetalcutting. **Grinding:**GrindingWheel,Abrasive&Bonds,GrindingWheelSpecifications,Grinding Wheel Wear, Attritions Wear & Fracture Wear, Dressing & Truing, SurfaceGrinding,Cylindrical Grinding&CenterlessGrinding **Machine Tools:** Working Principle, Constructions and Operations of Turret andCapstan Lathe, Tool LayOutTurretandCapstan Lathe, Shaper, Planer, Slotter,Milling,Dividing HeadandIndexing,Analysisofmaximumchipthickness,	22
II	**Additive manufacturing:**Introduction to Rapid Prototyping Technology (RPT),Rapid Manufacturing, Rapid Tooling Application and Advancement. Introduction ofSolid Based(SB),LiquidBased(LB),PowderBased(PB) RapidPrototyping. **AdvancedMachining:**WorkingPrinciple&ApplicationsofLaserBeamMachining (LBM),Electron Beam Machining (EBM), Electro chemical Machining(ECM),ElectricDischargeMachining(EDM),abrasiveJetMachining(AJM),UltrasonicMachining(USM)andPlasmaArcMachining(PAM)IntroductionofHybridMachining. **Super-Finishing Process**: Honing, Lapping & Buffing, Magnetic AbrasiveFinishing(MAF)	18

Text Book

- P.C.Sharma,"*ManufacturingTechnology(ManufacturingProcesses)*",S.ChandPublication,2006
- JainV.K.,"*AdvanceMachiningProcess*",PrenticeHall,2007.
- PPandey,HShan"ModernMachiningProcesses" McGrawHillEducation;Newedition2017
- GhoshandMalik,"*Manufacturingscience*",EastWestPvt.Ltd,2010.

Reference Books:

- Boothroyd, "Fundamental of Metal Cutting and Machine Tools", S. Chand, 2017.
- Jeffrey A. Hoffer "Modern Materials and Manufacturing Processes" Pearson Education 2007.
- Serope Kalpakjian, "Manufacturing Engineering and Technology (SI Edition)", 2018
- P. N. Rao, "Manufacturing Technology", Volume 2 | 4th E McGraw Hill Education; Forth edition, 2018.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

CO1:Understandand compare the functions and applications of metal cutting tools, cutting motions and concept of generatrix and directrix.
CO2: Calculatecutting forces (Pz and Px or Py) in straight turning at different feeds, velocitiesand depth of cut and able to construct Merchant's circle diagram.
CO3: Recognize chip formation mechanism and relevant matters (type, color & thickness) in turning mild steel and evaluate the role of variation of cutting velocity and feed on chip reduction coefficient /cutting ratio and shear angle
CO4:Understand the working principle of shaping machine, milling machine, Capstan lathe, Turret lathe and slotter machine
CO5: Apply the different metal removing ,finishing and super finishing techniques for component production, understand the concept of rapid prototyping and rapid tooling
CO6: Learn the basic concepts application of nontraditional machining processes

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO4/PSO3
CO2	PO1,PO2,PO3/PSO3
CO3	PO1,PO3/PSO3
CO4	PO1,PO5/PSO2,PSO3
CO5	PO1/PSO3
CO6	PO1/PSO3

BMEC0809: MANUFACTURING SCIENCE- II LAB

Objective:*The purpose of this lab is to enable the students to have the practical skills manufacturing operationsand design Jig and Fixtures, Cutting Tools, Measuring Tools, Press Tools for washer making, design of a circularform tool, design the gang milling arrangement of cutters , tooth profile & tolerances for arbor, cutter & key ,twist drill to machine the holes The student will also have practical exposure to analysis the cutting forcecomponentsofatoolpointwithdesignofvarioustoolanglesand machiningvariables.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	• DesignAProcessSheetShowingMachineTool,ToolLayout,OperationElements ,Jig&FixturesUsed,CuttingTool,MeasuringTool,CuttingConditionsfortheGive nComponentsasShownintheFigure. • ToDesignALayoutofFoundryShoptoProduce/ManufactureGivenComponent s. • Design A Drilling Jig for Drilling Four Holes on the Component as Shown intheFigure. • DesignASuitableMillingFixturefortheComponentShownintheFigure. • DesignAnIndexingJig/FixturefortheComponentShownintheFigure. • Design&DrawAPressTooltoProducetheComponentShownintheFigure. • Design & Draw A Press Tool Set to Produce A Washer at Each Stroke of thePress. The Washer is Made of Mild Steel 2 Mm Thick and 20 Mm is OutsideDiameter, Hole 8 Mm in Diameter. Assume Suitable Value of Shear StrengthofMaterial. • Design A Twist Drill to Machine A Hole in Cast Iron Gear Housing. The Holeis 20 Mm in Diameterby20 mm Deep and is Athrough Hole and theMachineToolisAVertical DrillPress. • Design the Gang Milling Arrangement of Cutters That You Would Providefor Machining of Faces Mark in Figure material of the Component is theCast Iron. Clearly Dimension Tooth Profile & Tolerances for Arbor, Cutter &Key. • DesignACircularFormToolfortheComponentShownintheFigure.AssumeSuit ableDataWhereverNecessary&AlsoFindtheToothProfile. • The Cutting Force Components of a Tool Point While Machining on MildSteelwitha10^0Back RakeAngle HighSpeedSteelToolis 105Kg. IfFeedis 0.06 Mm/Rev., Depth of Cut 2.2 Mm, Design a Suitable Cross Section of theTool, Assuming the Shear Strength of the Tool Material to Be 20 Kg. /$Mm^2$and A Factor of Safety is Approximately 2.5. The Young Module of the ToolMaterial is 20x10^3 Kg. /Mm^2. If the Maximum Permissible Deflection is 0.04Mm, Find the Extent by Which the Tool Can Be Projected Out of the ToolPost. RecommendSuitableValuesofToolAngles.Give ANeat Sketchofthe DesignedTool.	

Text Book:

- P. C. Sharma, "Manufacturing Technology (Manufacturing Processes)", S. Chand Publication, 2006
- P Pandey, H Shan "Modern Machining Processes" McGraw Hill Education; New edition 2017

- Ghosh and Malik, "Manufacturing science", East West Pvt. Ltd, 2010.

Reference Books:

- Boothroyd, "Fundamental of Metal Cutting and Machine Tools", S. Chand, 2017.
- Serope Kalpak jian, "Manufacturing Engineering and Technology (SI Edition)", 2018
- P. N. Rao, "Manufacturing Technology", Volume 2 | 4th E McGraw Hill Education; Forth edition, 2018.
- Rajender Singh, "Introduction to Basic Manufacturing Process & Workshop Technology", New Age International; Second edition, 2010.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

CO1:Understandofdesignofvariousmachinetools,cuttingtools&measuringtoollayoutandconsiderationofmachiningvariablesat differentcuttingconditions.
CO2:Demonstratepracticalskillsinthedesigningofpresstoolalongwithdieassemblyandtheoperationsperformedon them.
CO3:Calculateandoptimizethecuttingforcescomponentsofatoolpointbycuttingtool dynamometer.
CO4:Planandproducejobonshapingmachine,jobonmillingmachine,jobonplanerandslottermachine
CO5:Developamachiningprogramand processingofelectricdischargemachining.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/ PSO3
CO2	PO1/PSO3
CO3	PO1/ PSO3
CO4	PO1/PSO3
CO5	PO1/PSO3

BMEC0014:MODERN VEHICLE TECHNOLOGY (B. TECH. (AUTOMOBILE ENGG.))

Objective: *The course content should be taught and curriculum should be implemented with the aim to develop different types of skills leading to the achievement of the following competency:*

- ***Improveefficiency,security,safety&performanceofautomobileusingelectronicsandtechnology.***

Credits:04 **Semester III** **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Applications of Transducers & Sensors:** Concept of general measurement system&differencebetweenMechanicalandelectrical/electronicinstruments;MeasurementofTemperature:WorkingofThermocoupleandThermister;Measurement of Speed: Contact less electrical tachometer, Inductive, Capacitivetype tachometer, Stroboscope; Measurement of Force: Strain gauge load cell; BasicrequirementofSensors,Functions,ApplicationsandCircuitryarrangementofvariousSensorssuchasMassAirflowratesensor,ExhaustgasOxygenconcentration, Throttle plate angular position, Crankshaft angular position, Coolanttemperature, Intake air temperature, Manifold absolute pressure (MAP), VehiclespeedSensor, RainSensor&Rainsensing wiper. **AdvanceIgnitionsystem:**Electrical & electronics ignition system.ModernSpark Ignition system (e.g. D.T.S.I , T.D.S.I., Multi electrode etc. System)Insulatedcoils.ConceptofNon-batteryEnergyStorage:Ultra capacitorsandFlywheels. **AdvancementinEngineandrelatedcomponents:**Introduction&typesofhybrid vehicle. Hybrid drives systems. Compressed air car.Solar Cars. Hydrogenoperated Engine. Basicconcepts of Blue MotionTechnologies like DSG, TSI, TDI,GDI variablevalvetiming system.	28
II	**Modernization in Peripheral systems:** Security Systems. Remote keyless entry,Anti-theft system, Alarm system. Entertainment and peripheral systems. Integratedcommunications, Proximitysensors, Globalpositioning satellites(GPS). **Advance Safety Equipments:** Seat Belts, Seat Belts pre-tensioners, Smart seatbeltReminder,ConceptsofCrashtest,Crashsensors.AirbagsIntroductionofairbags, Duelstageairbags,SideAirbags.TirepressuremonitoringsystemPedestrianProtection& Nightvisionwithpedestriandetection. **Modern Features in Automobile:** Power Sliding doors. Electronic stability / Skid-control system, Traction control system. Telescopic steering wheel / adjustablepedals.RearmountedRadar&Cameras.Electromagneticsuspensionandlevitation. Automatic Lift Axle. Regenerative Braking Systems. Continuous VariableTransmission. IntelligentParking AssistSystem,Self Parking.	21

TextBooks:

- TomDenton,'AutomobileElectricalandelectronicsystems',ArnoldISBN-0750662190,thirdedition,2004.
- TharejaBL,'FundamentalsofElectricalandElectronicsEngineering',NirjaConstruction&DevelopmentCoLtd,NewDelhi,1984.
- PLKohli,'AutomotiveElectricalEquipments',TataMc-Graw Hill,NewDelhi,1983.
- A.K.SawhneyandPuneetSawhney,'ACourseinElectricalandElectronicMeasurementsand

ReferenceBooks:

- JohnTurner,'AutomotiveSensors',Momentumpress,LLCNEWYORKISBN-9781606500095,ISBN-1606500090, 2009.
- Barbara J. Peters, George A. Peters, 'Automotive Vehicle Safety', SAE International and Taylor & FrancisISBN -978-0-7680-1096-1,London,2002.
- J. Marek, H.-P. Trah Sensors, 'Automotive Technology', Y.Suzuki, I. Yokomor / ISBN – 3527295534Wiley-vch,weinheim, 2003.
- JeffDaniels, 'ModernCarTechnology', JHaynes&Co. Ltd.,2009

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:**Attheendofthecourse,astudentwillbeableto**

*CO1.Describeconstruction,functionsandapplicationsofvarioussensorsandactuatorsusedinmodernvehicle.**(Understand)***

CO2.*Explainmodern IgnitionsystemsofS.I.andC.I.Engines.**(Understand)***

*CO3DescribelatestadvancementinEnginetechnology.**(Understand)***

*CO4 Identifyand describevariousadvanced peripheralsystemusedinautomobile.**(Analyze)***

*CO5Demonstratevarioussafetyfeaturesand equipment usedinmodernvehicle.**(Apply)***

*CO6DescribevariousmodernfeatureslikeEBD,ABS,RegenerativeBrakingSystemetcforbetterfunctioningofvehicle.**(Understand)***

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO6,PO12/ PSO1
CO2	PO1,PO3,PO4,PO6,PO10/PSO1
CO3	PO2,PO3,PO4,PO6/ PSO1
CO4	PO2,PO3,PO4,PO6/ PSO1
CO5	PO3,PO6,PO9/PSO1
CO6	PO1,PO3,PO6,PO9/ PSO1

BMEC0015ADVANCEMATERIALSCIENCE

Objective: *Materials Science is focused on the fundamentals of biomaterials, nanomaterials, ceramics,metals,polymers,electronicmaterialsandcomposites,smartmaterials,greenandsustainablematerials emphasizing the relationships between atomic structure and microstructure as well as theproperties,processingandperformanceofthematerialinacohesiveandself-containedwaywithinthecourse.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**CrystallographyandImperfections:**ConceptofUnitCellSpaceLattice,Bravais-Lattices,AtomicPackingFactorandDensitycalculations,Millerindices,Imperfections,DislocationsTheory,Diffusioninsolids,Mechanicalproperties,elasticandvisco-elasticproperties **Fatigue**:Stresscycles,Factorsaffectingfatigue,crackpropagation, **Creep:**Creepcurve,stages increepcurve Stressrelaxation,DuctileandBrittlefracture,Griffiththeory,Seasoncracking **StrengtheningMechanism:**ConceptofGrainandGrainBoundary,Hall-Petchstrengthening,Solidsolutionstrengthening,precipitationstrengthening,dispersionstrengthening. **Equilibrium Diagrams:** Types of Equilibrium-Diagrams: Solid-SolutionType, Eutectic Type and Combination Type. Iron-Carbon Equilibrium-Diagram andItsImportance.	21
II	**Heat Treatment:** Various Types of Heat Treatment Such As Annealing,Normalizing,Quenching,TemperingandCaseHardening.TimeTemperatureTransformation(TTT)Diagrams. **Corrosion Science:** Definition and importance, Electrochemical reactions,Polarization,Passivity,Environmentaleffects,Eightformsofcorrosion,Cathodicprotection,Coatingsandinhibitors. High temperature materials and Materials for cryogenic applicationConcept of Magnetism and Magnetic materials, Superconductors and itstypes and phenomenon of Superconductivity, Metallic foams, Ceramics,Polymers,Composites,Carbonfibre,Graphene,NanoMaterials,Smart Materials.	23

TextBooks:

- GuptaK.M.,"*MaterialsScience*",UmeshPublication.
- RaghvanV.,"*MaterialScience*",PrenticeHall.
- Narula,"*MaterialScience*",TMH.
- Fontana,M.G.,"*CorrosionEngineering"*,TataMcGraw-Hill.

Reference Books:

- CallisterW.D., JR,"*MaterialScience&Engineering*",Addition-WesleyPublication.
- VlackVan,"*ElementsofMaterialScience&Engineering*",JohnWiley&Sons.
- Avner"IntroductiontoPhysicalMetallurgy"TMHPub

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

CO1: Understand the limits of materials and the change of their properties with use.
CO2: Create a new material that will have some desirable properties.
CO3: Prepare advanced composite materials for space and missile application.
CO4: Optimal selection of engineering materials that must simultaneously fulfill dimensional, property, quality control aspects.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3

BMEE0001 REFRIGERATION AND AIR CONDITIONING

Pre-requisite: *AppliedThermodynamics*
Objective: *TostudytheworkingofdifferentRefrigeratingandAirConditioningSystem&Analysisoftheirperformanceparameters.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Refrigeration:**IntroductiontoRefrigeration&MethodsofRefrigeration,Carnot RefrigerationCycleandItsLimitations,C.O.P. **Refrigerants:**ClassificationofRefrigerants,Nomenclature,DesirableProperties of Refrigerants, Secondary Refrigerants and CFC Free Refrigerants.GreenHouse Effect. **AirRefrigerationCycle:**OpenandClosedAirRefrigerationCycles,Reversed Carnot Cycle, Bell Coleman or Reversed Joule Air Refrigeration Cycle,Aircraft Refrigeration System, Classification of Aircraft Refrigeration System.BootStrapRefrigeration,Regenerative,ReducedAmbient,DryAirRatedTemperature(DART). Refrigerant Compressors; Classification, workdone, thermodynamic process,volumetricefficiency,principaldimensionsofreciprocatingcompressors, performancecharacteristics, **Vapour Compression System:**Single Stage System, Analysis of VapourCompression Cycle, Effect of Pressure, Sub Cooling & Superheating on C.O.P oftheCycle.Actual VapourCompressionRefrigerationCycle.	22
II	**MultistageVapourCompressionSystem**:RemovalofFlashGas,Intercooling,DifferentMultistageSystem, CascadeSystem. **VapourAbsorptionSystem:**WorkingPrincipleofVapourAbsorptionRefrigerationSystem, Ammonia– WaterVapourAbsorptionSystem, **AirConditioning:**IntroductiontoAirConditioning,PsychometricProperties and Their Definitions, Different Psychometric Processes, ThermalAnalysis of Human Body, Effective Temperature and Comfort Chart, CoolingandHeating LoadCalculations. Infiltration & Ventilation, Internal Heat Gain, Sensible Heat Factor (SHF), byPass Factor, Grand Sensible Heat Factor (GSHF), Apparatus Dew Point (ADP).ElementaryKnowledgeofTransmissionandDistributionofAirThroughDucts. **RefrigerationEquipment&Application:**AirWashers,FoodPreservation, Cold Storage, Refrigerator, Ice Plant, Water Coolers, CentralizedA.C.	21

Text Books:

- PrasadManohar,"*RefrigerationandAirconditioning*",NewAgeInternational(P)Ltd.Pub.
- C.P.Arora,"*RefrigerationandAirconditioning*", TMH.
- AroraandDomkundwar,"*RefrigerationandAirconditioning*",DhanpatRai&Co.

Reference Books:

- StoeckerandJones,"*RefrigerationandAirconditioning*",TMH.
- RoyJ.Dossat,"*RefrigerationandAirconditioning*", PrenticeHallIndia.
- P.L.Baloney,"*RefrigerationandAirconditioning*",SNTI,Publications.

- Kuhen,Ramsey&Thelked,"*ThermalEnvironmentEngg*",CentralBookAgency.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: At theendofthecourseastudent will beableto

CO1:illustrate thefundamentalprinciplesofrefrigerationandairconditioningsystems.
CO2:understanddifferentproperties,designationandenvironmentalissuesofrefrigerants
CO3:understandtheworkingofvapourcompressionandvapour absorptionrefrigerationsystems..
CO4:determinethecoolingcapacityandCOPofrefrigerationsystem.
CO5:analyzetheperformanceof psychometricprocessesusedforhumancomfort.
CO6:determinethecoolingload/heatingloadforagivenairconditioningapplication.
CO7:understand theworkingofIceplantandcoldstorage,airwasher.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO10/PSO1
CO2	PO1,PO7,PO12/PSO1
CO3	PO1,PO10/PSO1
CO4	PO1,PO4,PO10/PSO1
CO5	PO1,PO4,PO6,PO10/PSO1
CO6	PO1,PO4,PO10/PSO1
CO7	PO1,PO10,PO12/PSO1

BMEE0170 REFRIGERATION AND AIR-CONDITIONING LAB

Objective: *Tomakestudentsfamiliarwiththevariousdevicesassociatedwith Refrigeration&Air-Conditioning.Theexperimentsaredesignedtoprovideexposureofpracticalaspectsofthevarioustheoreticalconceptsdevelopedduringtherefrigerationandairconditioningcourse.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	List ofExperiments: • ToStudyBasicComponentsofAir-ConditioningSystem. • ExperimentonRefrigerationTestRigandCalculationofVariousPerformanceParameters. • ToStudyDifferentTypesofExpansionDevicesUsedinRefrigerationSystem. • ToStudyDifferentTypesofEvaporatorsUsedinRefrigerationSystems. • ExperimentonAir-ConditioningTestRig&CalculationofVariousPerformanceParameters. • ToStudyAirWashers. • StudyofWindowTypeAirConditioner. • VisitofaCentralAirConditioningPlant andItsDetailedStudy. • VisitofCold-StorageandIts Detailed Study. • ExperimentonIce-Plant toFind OuttheCapacityofPlant. • Experiment on Two Stage Reciprocating Compressor forDetermination ofVolumetric Efficiency,PVDiagram. • StudyofCompressors- HermeticallySealed. • ExperimentonDesertCoolers. • StudyofCentralAir-ConditioningSystems	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Oncompletionofthelabstudentswillbeableto*

CO1:illustratethefundamental workingprinciples ofvapourcompressionrefrigerationsystem.
CO2:recognizethecomponents(expansiondevices,evaporators,condensers,compressors)andunderstandtheiruseinrefrigerationsystem.
CO3:illustratetheworkingofvapourcompressionandvapourabsorptionrefrigerationsystems.
CO4:analyzetheperformanceparametersofvapourcompressionandvapourabsorptionrefrigerationsystems.
CO5:analyzetheperformanceof psychometric processesusedinairconditioning.
CO6:developprototypemodel ofrefrigerationsystemusedinIceplants,airwasher.
CO7:determinethecapacityofwindowand splitairconditioningsystem.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO10/PSO1
CO2	PO1,PO10,PO12/PSO1
CO3	PO1,PO10/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4,PO6,PO9,PO8,PO10/PSO1
CO6	PO1,PO4,PO10,PO12/PSO1
CO7	PO1

BMEE0002INTERNALCOMBUSTIONENGINE

Pre-requisite: *AppliedThermodynamics*

Objective: *The objective of this course is to give an introduction of internal combustion engines with emphasison their engineering applications. The focus is on explaining engine performance in terms of power, energyutilizationandexhaustemissions,itsrelationtointernalprocesseslikecombustionandvaryingengineoperating conditions.*

Credits:03 L–T–P:3–0–0

Module No.	Content	Teaching Hours
I	**Introduction to I.C. Engines**: Engine classification and basic terminology,Two and four stroke engines, SI and CI engines, Valve timing diagram, Engineperformanceparameter.ThermodynamicanalysisofAirstandardcycles,Ottocycle,Dieselcycle,Dualcycle,ComparisonofOtto,DieselandDualcycles. Introduction to Fuel air cycle & Actual cycle, factors affecting the fuel air cycle&Actual cycle. **SI Engines:** Combustion in SI engine, Stage of Combustion, Flame speed,Ignition delay, Abnormal combustion and its control, combustion chamberdesignforSIengines,Carburetor,Carburetion,Mixturerequirements,CarburetorsandfuelinjectionsysteminSIEngine,Ignitionsystemrequirements,Magneto andbatteryignition systems.	23
II	**CI Engine:** Combustion in CI Engines, Ignition Delay, Knock, AbnormalCombustion, Combustion chamber design of CI engines, Fuel Injection SystemofCIEnginesandTheirComponents, Injection Timings. **Fuels:** Fuels for SI and CI engine , Important qualities of SI and CI enginefuels, Rating of SI engine and CI engine fuels, Gaseous fuels, LPG, CNG, Biogas,AlternativefuelsforICengines,NormslikeEuroandBharatNorms. **Supercharger&Turbocharger***:*Introductiontosuperchargerandturbocharger,TypesofSuperchargingMethods,CalculationofSupercharger. BasicConceptsofAdvancedEngines.	22

TextBooks:

- Mathur&Sharma,"*ACourseinInternationalCombustionEngines*",DhanpatRai&Sons.
- R.Yadav,"*I.CEngine*",CentralPublishingHouse,Allahabad.
- Ganeshan,"*I.CEngine*",TataMcGrawHillPublishers.

ReferenceBooks:

- Gill,Smith&Ziurs,"*FundamentalsofInternalCombustionEngine*",Oxford&IBHPublishingCo.
- Rogowsky,"*ICEngines*",InternationalBookCo.
- E.FObert,"*I.CEngineAnalysis&Practice*",S.Chand.
- Engineering Fundamentals ofInternalCombustionEngines byW.W. Pulkrabek,PearsonEducation.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

CO1:Recognize and understand the reasons for differences among operating characteristics of differentenginetypesanddesigns.

CO2: Analysis of different power cycle of internal combustion engines using ideal gas cycles, air cycles,and fuel-aircycles.

CO3: Characteristic of homogeneous combustion in SI-engines and spray combustion in CI-engines. FuelqualityrequirementsofSI-andCI-engines.

CO4: Fuel economy trends with its history and norms.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO3,PO4/PSO3

BMEE 0003: AUTOMOBILE ENGINEERING

Pre-requisite:InternalCombustionEngine

Objective:Tomakestudentawareofbasicknowledgeofautomobilesystemsandsubsystems.To makestudents aware of maintenance and overhauling of a vehicle. To show students how various system and sub-systeminvehicleworkstogether.Totellstudentsaboutlatestdevelopmentinthefieldofautomobileengineering.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Power and Transmission System:**Power and Torque Characteristics,RollingResistance,AirResistance,GradientResistance,TractiveEffortonPowerofAutomobile,ConceptofGearRatio,GearBoxandTheirTypes,SelectorMechanismofGearBox.RequirementsofGoodTransmissionSystems,ClutchesandTheirTypes,OverDriveandFreeWheel,TorqueConvertersDifferentialGearMechanism,AutomaticTransmissionandItsComponents, Propeller Shaft, Slip Joints, Universal Coupling, Final Drive andtheirTypes,AdvancesinTransmissions. **VehicleHandlingandControlSystem:**TypesofSteeringMechanism,SteeringGeometry, Working ofElectrical&HydraulicPowerSteering.	20
II	**Vehicle Handling and Control System:**. Requirement of Braking System,VariousTypesofBrakingSystem,AntiLockingBrakingSystem,EBD(ElectronicBreakingForceDistribution).FrameandTheirTypes,LoadonFrame,GeometryofSuspensionSystem,Dampers,VariousTypesofSuspensionSpringsTypesofFrontAxleIndependentSuspensionSystem.AdvancesinVehicleHandling&ControlSystem. ***Electrical System:*** Types of Ignition System Used in Automobiles and TheirWorking, Alternator, Battery, Starting Motor, Lighting System, Horn, Relays,WindscreenWiper,SpeedometerEtc. ***Cooling & Lubrication System:*** Requirements, Various Components, Types ofCoolingandLubricationSystems, HeatingandCoolingUnitofAutomobiles. Features,TechnicalSpecifications,AdvancesinAutomobileEngineering.	20

TextBooks:

- **JainK.K.**and**Asthana.R.B**,“AutomobileEngineering”Tata McGraw HillPublishers,NewDelhi, 2002.
- **SinghKripal,**“*AutomobileEngineering*”,Vol.1&Vol.2,StandardPublisherNewDelhi,2007.
- **K.M.Gupta**, AutomobileEngineering,Vol. 1&Vol.2,UmeshPublications.NewDelhi,2001.
- **NakraCP**, BasicAutomobile, DhanpatRaiPublicationCo.Ltd7thEdition2005.

ReferenceBooks:

- JosepeHeitnerAutomotiveMechanics–PrincipleandPractice,EastWestPress2ndedition1999
- CrouseW andAnglinD, AutomotiveMechanics, TataMcgraw HillPublicationltd10thedition2004

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome:Attheendofthecourse,astudentwillbeableto

CO1. *UnderstandandexplaintheeffectsofResistanceforces onthepower ofanautomobile.**(Understand)***

CO2.*DescribefunctioningofTransmissionsystem, conventionalandnon-conventional drives,Clutches,Gearboxes,Synchromeshdevice,Propellershaft,Differentialaxle,Overdrive,Freewheel..**(Understand)***

CO3.*Understandtheconceptoffiringorderformulti-cylinderenginesforignitingoffuels.* ***(Apply)***

CO4.*Describefunctioningofsteeringsystem,steeringgeometrywheelalignmentandwheelanglesformodernAutomobile.**(Understand)***

CO5.*Demonstrateandexplainvarioustypesofsuspensionsystem,brakingsystemandnewsafetysystemforanautomobilelikeEBD, ABS.**(Apply)***

CO6.*UnderstandtheimportanceofelectricalsystemsinAutomobileandnumberofsubsystemslikestartingsystem,Chargingsystem,Alternators.**(Understand)***

CO7.*Developconceptanddefineworking ofAutomobileEnginecoolingandlubricationsystem.**(Understand)***

MappingofCourseOutcomes(Cos)withProgram Outcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO4/PSO1
CO2	PO1,PO3,PO4,PO6,PO10/ PSO1
CO3	PO2,PO3,PO4,PO6/ PSO1
CO4	PO1,PO2,PO3,PO4,PO6,PO12/ PSO1
CO5	PO3,PO6,PO9/PSO1
CO6	PO1,PO3,PO6/PSO1
CO7	PO1,PO3,PO6,PO12/PSO1

BMEE0171: AUTOMOBILE ENGINEERING LAB

Objective: *The main objective of this lab is to make students aware of various systems like braking system,Steering system, suspension system and electrical system of a vehicle. This lab is also dedicated to engine testingand performance in which various parameters of engine are calculated. Working of some new and moderntechnologylikeautomatictransmissionandMPFIisalsodemonstratedtothestudents.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments: • Performance Analysis of Four Stroke S.I. Engine- Determination ofIndicated and Brake Thermal Efficiency, SpecificFuel ConsumptionAtDifferentLoads, andPreparationofEnergyBalanceSheet. • DeterminationofIndicatedH.P. ofI.C. EnginebyMorseTest. • Performance Analysis of Four Stroke C.I. Engine- Determination ofIndicated and Brake Thermal Efficiency, SpecificFuel ConsumptionAtDifferentLoads,andPrepareEnergyBalanceSheet. • ToStudytheWorkingPrincipleof GearBoxes. • TroubleShootingonDifferentialGearMechanismofRearAxle. • MeasurementofSteeringGeometryAnglesandTheirImpactonVehiclePerformance.. • TroubleShootingonAutomobileBrakingSystem. • TroubleShootingonIgnitionSystemofI.C. Engine. • Trouble Shootingon Fuel Supply System ofS.I.Engines-Carburetor,FuelInjectionPumpandMPFI. • TroubleShootingonFuelSupplySystemofC.I.Engines-Injector&FuelPump. • StudyofAirConditioningSystemofanAutomobile.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome: Studentshavestudiedabout:

Attheendofthecourse,astudent willbeableto

CO1.The student will be able to perform Brake Performance test analysis of Four Stroke S.I & C.I Engine and willbeabletodiagnosethefault. (Apply)

CO2.Thestudentwillbeabletounderstandtheroutineservicing,testingandtroubleshooting,overhaulingofa clutchandgearboxassembly.(Analyze)

CO3.ThestudentwillbeabletounderstandtroubleshootingonFuelSupplySystemofS.I&C.IEngines. (Understand)

CO4.ThestudentwillbeabletounderstandthefunctioningofIgnitionSystem&BrakingSystemofI.C.Engine. (Understand)

CO5.ThestudentwillbeabletodetermineIndicatedH.P.ofI.C.EnginebyMorseTest.(Apply)

CO6.TheStudentwillbeabletoperformminorandmajortuningofgasolineanddieselengines.(Analyze)

MappingofCourseOutcomes(Cos)withProgramOutcomes (Pos)andProgramSpecificOutcomes(PSOs):

COs	***POs/PSOs***
CO1	***PO2,PO3,PO4,PO6/PSO1***
CO2	***PO3,PO6,PO9/PSO1***
CO3	***PO1,PO2,PO4,PO10/PSO1***
CO4	***PO1,PO2,PO3,PO4,PO6,PO12/PSO1***
CO5	***PO2,PO3,PO6,PO9/PSO1***
CO6	***PO3,PO4,PO6,PO9/PSO1***

BMEE0004 POWER PLANT ENGINEERING

Pre-requisite:AppliedThermodynamics
Objective:Tomakestudentconversantwith variouscomponentsandoperationsofdifferentpowerplantsandpowerplanteconomics..

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** The Sources of Energy, Development of Power Generation inIndia,RankingCycle,Reheat.Regeneration. **Power Plant Economics and Environmental Considerations**:Costsofpowergeneration,GeneralArrangementofPowerDistribution,LoadCurves, Load Duration Curve, Economic Scheduling, Definitions of ConnectedLoad,MaximumDemand,DemandFactor,AverageLoad,LoadFactor,DiversityFactor–RelatedExercises. **EffluentsFromPowerPlant:**ImpactonEnvironment,PollutantsandPollution Standards,MethodsofPollutionControl. **Steam Power Plant**: Plant Layout, Working of Different Circuits, Types ofcoal, Coal Handling, Dust and Ash Handling Systems.**Combustion Process:** Coal Stokers, Pulverized Fuel Burning System and ItsComponents,CombustionNeeds andDraughtSystem,CycloneFurnace. Feedwatertreatment,PlantAuxiliaries**.**	20
II	**HydroElectricPowerPlant**:HydrologicalCycle,Hydrographs,.PlantClassification, Typical Layouts, Plant Auxiliaries, Classification of Dams andSpillWays, PlantOperation. **NuclearPowerStation**:NuclearFuels,NuclearReactors,ReactorOperation.PressurizedWaterReactor,BoilingWaterReactor,Sodium-Graphite Reactor, Fast Breeder Reactor, Homogeneous Reactor, Gas CooledReactor,RadiationHazardsandShielding–RadioactiveWaste Disposal. **Gas Turbine Plant**: Introduction, Classification, Construction – Layout WithAuxiliaries, Principles of Working of Closed and Open Cycle Gas power plant.CombinedCycle PowerPlantsandComparisons. **PowerFromNon-ConventionalSources**:Solarenergy.WindEnergybasedpowerplant-PrincipleofWorking,,MHDpowerGeneration.	22

TextBooks:

- P.K.Nag,“*PowerPlantEngineering*”:TataMcGraw-HillPublishingCompany,Ltd.
- P.C.Sharma“*PowerPlantEngineering*”,S.K.Kataria Pub.

ReferenceBooks:

- M.M.ElWakil,“*Power PlantTechnology*”:TataMcGraw- HillPublishingCompany,Ltd.
- A.J.WoodandB.F.Wollenberg“PowerGenerationOperationandControl”:Wiley.
- G.D.Rai,“Non-ConventionalEnergySources”:KhannaPublishers.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Afterthecompletion ofcourse,Students willbeableto:

CO1:describethelayoutandcomponentsofthermalpowerplant.
CO2:analyzetheperformanceof thermalpower plant basedontheRankincycle.
CO3:describethelayoutandcomponentdetailsofhydroelectricpowerplant.
CO4:describethelayout,componentdetailsofgaspowerplantandnuclearpowerplant.
CO5:analyzetheperformanceof gaspower plantbasedontheBraytoncycle.
CO6:understandthebasicprinciplesofeconomicsofpowergenerationandenvironmentalhazardsofpowerplants.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO10,PO12/ PSO1
CO2	PO1,PO2,PO4/PSO1
CO3	PO1,PO10/ PSO1
CO4	PO1,PO6,PO7,PO10/PSO1
CO5	PO1,PO2,PO4/PSO1
CO6	PO1,PO7,PO10/PSO1

BMEE0005 GAS DYNAMICS

Pre-requisite:*AppliedThermodynamics*

Objective: *The main objective of the course is to provide an insight into the applications of compressible flowand to enable the students formulate and solve problems in one dimensional steady compressible flow includingisentropic nozzle flow, constantareaflowwithfriction or with heattransfer.*

Credits:04 L–T–P:3–1–0

Module No.	Content	TeachingHours
I	**Basics of Fluid Mechanics**: Conservation laws for mass and Momentum,Velocity of sound, Bulk modulus of elasticity, Coefficient of Compressibility,Stagnation state, Critical state, Various regions of flow, Differences betweenIncompressibleandCompressibleflows,Reynoldsnumberanditssignificance.**Fundamentals of compressible flow:** Objective and applications ofcompressible flow, Ideal gas relationship, The adiabatic energy equation,Physical significance of Crocco number and Mach number, Characteristic Machnumber, Critical Mach number, Mach waves, Mach cone and Mach angle, staticand stagnation states, relationship between stagnation temperature, pressure,density and enthalpy in terms of Mach number, stagnation velocity of sound,reference speeds, various regions of flow, Effect of Mach number oncompressibility, Area velocityrelationship. **Isentropic flow through a variable area duct**: General features of isentropicflow, performance curve, Comparison of adiabatic and isentropic process, Onedimensionalisentropicflow inductsofvaryingcross-section-nozzlesanddiffusers, operation of nozzles under varying pressure ratio, Mach numbervariation, Area ratio as a function of mach number, Impulse function, Massflowratethroughnozzlesanddiffusers,Phenomenonof choking,subsonic and supersonicdesigns.	22
II	**Flowthrough constantareaductswithfriction:**Objective,outcomeandassumptions of Fanno flow,Fanno curves, Equation andits solution,Variationofflowpropertieswithductlength.Isothermalflowwithfriction, Variationofflow properties. Tables and charts for Fanno flow. Applications of Fanno flow.**Flowthroughconstantareaductswithheattransfer**:Rayleighflow,Rayleighflowequation,Rayleighline,Variationofflowproperties,Maximumheattransfer. Basic formulation of non Isothermal flow with heat transfer and friction**Normal Shock Gas Dynamics:** Development of shock wave, governingequations,Prandtl–Meyerrelation,RankineHugoniotrelation,Impossibilityofrarefaction shock, Mach number downstream of shock, Property variationacrossshock,Strengthofshockwave,entropychange,supersonicdiffuser. NormalshocksinFannoandRaylighflow.Introductiontoobliqueshockflow.	21

TextBooks:

- *1.FundamentalofCompressibleflow,S.M.Yahya,NewageinternationalPublication,Delhi*
- *2.Fundamentalsofcompressiblefluiddynamics-P.Balachandran,PHILearning,NewDelhi*
- *3.GasDynamics,E.Rathakrishnan,PHILearningPvt. Ltd*

ReferenceBooks:

- *1.ThedynamicsandthermodynamicsofCompressiblefluidlowVolume-I,AscherH.Shapiro,theRonaldPressCompany,NewYork.*
- *2.GasDynamicsandJetPropulsion-P.Murugaperumal,ScitechPublication,Chennai.*
- *3.ModernCompressibleFlow:WithHistoricalPerspective,JohnD.Anderson,McGraw-HillHigherEducation*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

CO1:Conceptsandresultsforthecompressibleflowofgasesandintroductiontothenumericalmethodofcharacteristics.
CO2:Conservationlaws,propagationofdisturbances,isentropicflow,compressible flowinductswithareachanges, normal and obliqueshockwavesandapplications.
CO3:Prandtl-Meyerflow,FannoflowandRayleighflowwithapplicationstonozzlesandonedimensionalunsteadyisentropic flow
CO4: physicalunderstanding ofthe phenomena andbasicanalyticalresults.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO4/PSO3

BMEE0006 GAS TURBINE AND JET PROPULSION

Pre-requisite:AppliedThermodynamics

Objective: *Students will be able to understand propulsion systems in aircraft that are essential to graduateengineers who are intended to work in aircraft system/component manufacturing/maintenance environments.Students should be able todescribe thekeyaeronautical engineering featuresin the contextofwhichtherelevant industryoperates.*

Credits:04 **L–T–P:3–1–0**

ModuleNo.	Content	TeachingHours
I	**IntroductiontoGasTurbine:**Simplegasturbineandreviewof Braytoncycle. **CycleArrangements:**Opencyclearrangement,closedcyclearrangement. Basicrequirementsofworkingmediumanditsproperties. **Idealcyclesandtheiranalysis:**Simplegasturbinecycle,heatexchange cycle, reheat cycle, intercooled cycle, combinations of variouscycles,comparisonof variouscycle. **Impulseturbineandreactionturbines:**Introductiontoimpulseturbineandreactionturbines,Multistagemachine,compoundingofturbines.	22
II	**Elementary turbine design:** Velocity triangleofsinglestageturbine,Expressionforworkoutput,bladeloadingand flowcoefficients,bladeand stage efficiencies, Blade to gas speed ratio, losses and efficiencies.**Aircraft Propulsion:** Introduction, types ofaircraftenginesandtheiranalysis(gasturbineengines,turbojetengines,turbofanengines,turbopropengines) **Aircraftpropulsiontheory:**Thrust,thrustpower,propulsiveefficiency,ram efficiency,thermalefficiencyandoverallefficiency.	23

TextBooks:

- CohenandRogers,'GasTurbineTheory',DorlingKindersley(India)pvt.Ltd.,Noida.
- V.Ganesan,'GasTurbines',TataMcGrawHills,NewDelhi.
- S.M.Yahya,'Turbines,Compressorsandfans',McGrawHills,NewDelhi.

ReferenceBooks:

- JackD.Mattingly,'ElementsofGasTurbinePropulsion',TataMcGrawHills,NewDelhi.
- Mathurand Sharma,'GasTurbineandJet&RocketPropulsion',Standardpulishers,Delhi.
- AhmedandSayed,'AircraftpropulsionandGasTurbineEngines'CRCpress,TaylorandFrancis.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

CO1:Outlinegoverningequationsofcompressiblefluidflow.
CO2:Analyzeonedimensionalcompressibleflowthroughvariableareaduct.

CO3:Analyzecompressibleflowhavingnormalshock.
CO4:Applygoverningequationstocompressibleflowthroughconstantareaduct withfriction.
CO5:Applygoverningequationstocompressible flowthroughconstantareaductwithheattransfer.
CO6:Interpretpropulsivesystemsfortheir workingandapplication.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO4/PSO3
CO4	PO2,PO4/PSO3
CO5	PO2,PO3/PSO3
CO6	PO3,PO4/PSO3

BMEE0007 ADVANCED HEAT TRANSFER

Pre-requisite:*Heat&MassTransfer*
Objective: *Todevelop theunderstanding ofstudents tosolve the reallife applicationsbyapplyingthelawsofheattransfer.Analysisofheattransfermechanismsincombined modesofheattransfer.*

Credits:04 **L–T–P:3–1–0**

ModuleNo.	Content	Teaching Hours
I	TransientHeatConduction,Convection,NumericalSolutionofConductionproblemsandMassTransfer,Finitedifferenceequations method of energy balance, finite difference formulationof unidirectional for Cartesian cylindrical coordinate of variouskindofboundaryconditions,heatconductionproblems,numerical methods of solutions, numerical solution of transientheatdiffusionproblems.EmpiricalcorrelationsofFreeandforcedheat transfer. Heat exchanger heat transfer problems. Thermalboundarylayer thickness.	22
II	Convectivemasstransferequationsandtheirapplications.Boundarylayermasstransferempiricalcorrelationsforconvectivemasstransfer. Heat Transfer by Radiation, Boiling and Condensation, nucleatepoolboilingandempiricalcorrelationsforpoolboilingheattransfer, factors affecting pool boiling film coefficients, high heatfluxboiling.Laminarfilmcondensationonaverticalplate,turbulentfilmcondensation,dropswisecondensation.	23

Text Books:

- J.P.Holman"HeatTransfer"Mac-GrawHillspublication,2017
- YadavR.,"*HeatTransfer*",CentralPublishingHouse,Allahabad,2018

Reference Books:

- Bayazitouglu&Ozisik, "*ElementsofHeat transfer*",T.M.H.,2015
- Pitts&Sisson,"*Schaum'soutlineofHeatTransfer*",McGraw-HillInternationaledition,2018
- Frank Kreith,"*PrinciplesofHeatTransfer*",McGraw-HillBookco.,2019

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes: Aftercompletionofcourse,thestudentswillbe ableto:

Determinetheheattransferthroughcompositewallofa Furnaceundergivenboundaryconditions.
Determinethenumericalheattransferofcompositesystemundersteadystateconditionofheattransfer.
Determinethenumericalheattransferofcompositesystemunderun-steadystateconditionofheat transfer.
Establishempiricalrelation foragiven heattransferapplication.
Understandmassdiffusion rateincaseofevaporativecooling incoolingtowers.
Understandthe effectsoffoulinginboilertubesofthermalpowerplant.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO1,PO2/PSO1,PSO2
CO6	PO1,PO2/PSO1,PSO2

BMEE 0008 SOLAR ENERGY

Objective: *Solar energy is ultimate energy resource available on planet earth. Objective of this course is to make students aware about many facets of solar energy. How solar energy can be harnessed for various applications. Ultimate objective of this course is to train students about integration of solar energy devices in buildings, agricultural and other mechanized means.*

Credit:03 **L-T –P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:**generalintroductiontorenewableenergytechnology,Solarenergypotentialin India, energy demands and renewable energy. current and future scenario.**Solarradiation**:Directanddiffusedradiation,Radiationmeasuringequipment.Basics ofsolarangles. **Solarcollectors**:basicworkingofcollectors,FPSC,PTC,Solarconcentrators, , tracking mechanism,Solar energy storage systemsdesignsandperformanceanalysisbased onstandard norms. **Applications** in water heating systems, steam generating with solarenergy.Phase changingmaterialsforenergystorage	20
II	Solarairheatingsystems,Spaceheatingandcoolingprocesses PV Systems,hybrid PV/Tsystems.Renewableenergy desalinationsystems.Energyconversionsystemsbasedonbio-mass,Photosynthesisbasic conceptandworkingoffuelcell. Active & Passive building applications. Economics (IRR, LCOE,ROI)Design,modelingand simulationofsolarenergysystems.	22
	Totalhours	**42hours**

Text Books:

- S.PSukhatmeandJ.KNayak.“Solarenergy,principleofthermalcollectionandstorage”
- S. Kalogirou “Solarenergyengineering:processesandsystems.”ISBN978-0-374501-9

Reference Books:

- YogiGoswami“PrincipleofSolarengineering”, CRCPress,Thirdedition.
- J.ADuffie&W.ABeckman“Solarengineering&thermalprocesses”JohnWiley&Sons,4ed.
- G.NTiwari“Solarenergy:Fundamental,design,ModelingandApplications”ISBN-10:0849324092
- C.P.Arora“Refrigerationandairconditioning”TataMcgraw-Hill PublishingCompany,2ndEd.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

CO1.Understandworkingofsolarradiationmeasuringequipments
CO2.Determinemagnitude ofincidentradiation.
CO3. Understandworkingofsolarcollectorsystems.
CO4.Applyknowledgetodesignimprovedsolarenergybasedsystems.
CO5.Analyzeprocessesofspaceheating and coolingsystems.
CO6. Canperformmodelingandsimulationforperformanceanalysistooptimizethesystemefficiency.
CO7.Designanddevelop smallsolar energybased systemssuitableforruralareas.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PSO1
CO2	PO4/PSO1
CO3	PO1,PSO1
CO4	PO3,PO5,PSO1,PSO2
CO5	PO7,PO9,PO3,PSO1,PSO3
CO6	PO3,PO4,PO5,PSO1,PSO3
CO7	PO3,PO6,PO7,PO10,PO12,PSO1,PSO3

BMEE0172SOLARENERGYLAB

Objective:*Todevelopthecapabilityofstudentstounderstandsolarenergyharvestingsystemsandto applyacquiredknowledgetofulfillthesocialneeds.*

Credits:01 **L–T–P-J:0–0–2-0**

Exp.No	Experimentobjective	Hours
1	TodeterminethermalefficiencyofFPSCinindoorcondition	2
2	TodeterminethermalefficiencyofFPSCinnaturalmode	2
3	Todeterminethermalefficiencyofsingleaxisparabolictrough collector	2
4	TodeterminethermalefficiencyofPTC (doubleaxis)	2
5	Determinethermalefficiencyofsolarairheatingsystem	2
6	Todeterminecharginganddischargingefficiencyofenergy storagesystem.	2
7	Todetermineoverallheat transfercoefficient ofenergystorage system.	2
8	Todetermineoverallheat transfercoefficient ofFPSC.	2
9	Tostudysolartrackingsysteminparabolictroughcollector	2
10	Toanalyzethethermalperformanceofheatpipeuseinsolar collectorsystem.	2
11	Tostudyworking ofPV/Tsystemforsolarenergyabsorption	2
12	Tostudyworkingofthermalimagingcameraand itsapplication	2

Text/Referencebooks:

- “Renewableenergypowerfor sustainablefuture”,oxforduniversitypress.
- S.PSukhatmeand J.KNayak “Solarenergy,principleofthermalcollectionand storage”
- S.Kalogirou“Solarenergyengineering:processesandsystems”ISBN978-0-374501-9

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

CO1:Tounderstandworkingofsolar radiationmeasuringequipments.
CO2:Determine magnitudeofincidentradiation.
CO3:Analyzeperformanceofvarioussolar collectorsystems.
CO4:Applytheirknowledgetodesignimprovedsolarenergybasedsystems.
CO5:Designandanalysesworkingofspaceheatingandcoolingsystems.

Mapping of Course Outcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO4,PO5,PSO1
CO4	PO3,PSO1
CO5	PO3/PSO1

BMEE0186 PROJECT BASED SOLAR ENERGY LAB

Credits:02 **L–T–P-J:0–0-0-8**

Objective: *To train and guide students for modeling, design and fabrication of projects based on solar energy harvesting and applications in rural and industrial sector.*

1. Roleofnanofluidasaheattransferfluidinthermalenergystorageusingphasechangematerials.(Like MWCNT)
2. Experimentalinvestigationonthermalperformanceofheatpipe.
3. Experimentalphotovoltaicthermaltrainingsystemdomestictype.
4. Thermal energy storage via parabolic trough collector in high melting pointtemp.PCM.(likefattyacids)
5. Designandfabricationofflatplatesolarcollectorand investigatetheoverallefficiency.
6. Designandfabricationofparabolictroughcollectorandinvestigatetheoverallefficiency.
7. Designandfabricationofsolarairheaterandanalysisonefficiency.
8. Determinetheperformanceofparabolictroughcollectorwithfixedparametersandproperinsulationofstoragetank.
9. Designandfabricationofsolardryerandinvestigateefficiency.
10. DesignandanalysisofPV/T Solarairspaceheatingsystem.

Textbooksandreferences:

Text/Referencebooks:

- “Renewableenergypowerforsustainablefuture”,oxforduniversitypress.
- S.PSukhatmeand J.KNayak “Solarenergy,principleofthermalcollectionandstorage”
- S.Kalogirou“Solar energyengineering:processesandsystems”ISBN978-0-374501-9

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

CO1:Applyacquiredknowledgeindesignofbasic solarenergyapparatus.
CO2:Applyknowledgeofbasicsciences,heatandmasstransfer,thermodynamicsinanalysisof solarapparatus.
CO3:Analyzeperformanceofvarioussolar collectorsystems.
CO4:Applytheirknowledgetodesignimprovedsolarenergybasedsystems.
CO5:Integrate/applysolarsystemsforapplicationsinspace

heatingandcoolingrequirement.
CO6: Provide solution to ruralandurbanpeopleregardingenergysaving andutilization

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO4,PO5,PSO1
CO4	PO3,PSO1
CO5	PO3/PSO1
CO6	PO6/PSO1

BMEE0009 INTRODUCTION TO VEHICLE DYNAMICS

Typeofcourse: *Elective (MechanicalEngineering),Advanced/Applications(AutomobileEngineering)*

Pre–requisite: *Kinematics of Machines, Dynamics of Machinery (MechanicalEngineering), AutomobileSystem, Physics (AutomobileEngineering)*

Objective: *To understand the principle and performance of vehicle in various modes such as longitudinal, vertical and lateral directions. At the end of the course the student will be able to identify the various forces andloadsand performanceunderacceleration, rideand braking.*

Credits:04 **Semester VI** **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:**IntroductiontoVehicleDynamics,LongitudinalDynamics,VehicleLoadDistribution – Acceleration and Braking - Brake Force Distribution, Braking Efficiency.**Aerodynamics:**MechanicsofAirFlowAroundaVehicle,Pressure DistributiononaVehicle,AerodynamicForces,DragComponents,AerodynamicsAids.**TireMechanics:**TireConstruction,SizeandLoadRating,TerminologyandAxisSystem,TractiveProperties,CorneringProperties,CamberThrust,AligningMoment,CombinedBraking andCornering,ConicityandPlySteer,Slip,Skid	25
II	**Tire Mechanics:** Rolling Resistance, Elastic Band Model for longitudinal slip, Simplemodel for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut stringmodel for lateral slip, Magic Tire Formula. **Motorcycle Dynamics:** Kinematic structureof motorcycle, geometry of motorcycles, importance of trail, Resistance forces acting onmotorcycle(tyrerollingresistance,aerodynamicresistanceforces,resistantforcecausedbyslope),Location& heightofmotorcycle'scentreofgravity(C.G),Momentsof inertiaonMotorcycle.IntroductiontoFront&RearsuspensionsofMotorcycle	25

TextBooks:

- WongJY,"TheoryofGroundVehicles",JohnWiley&Sons,NewYork,1978.
- MillikenWFandMillikenDL,RacecarVehicleDynamics,SAE.
- Garrett T K, Newton K and Steeds W, "Motor Vehicle", Butter Worths & Co., Publishers Ltd., NewDelhi, 2001.

ReferenceBooks:

- R N Jazar, Vehicle Dynamics: Theory and Application, SpringerRogowsky, "*IC Engines*",

InternationalBookCo.

- HansPacejka,TireandVehicleDynamics,Elsevier,2012.
- ThomasDGillespie,"FundamentalsofVehicledynamics",SAEUSA1992.
- RajeshRajamani,VehicleDynamics&control,Springer.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheendofthecourse,astudentwillbeableto

CO1.Understandthedynamicsofvehicleride.

CO2.Calculateandrefertheloadsandforcesassociatedtothevehicles.

CO3.Analysethebehaviorofthevehiclesunderacceleration,rideandbraking

CO4.Understandhowpassengercomfortisachievedalongwithvehiclestability.

CO5.Understandandexplaintheeffects ofResistanceforcesonthepowerofanautomobile.

CO6.Abilitytounderstandaboutsuspensionandtyrerelatedvibrations.

MappingofCourseOutcomes (Cos)withProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	*POs/PSOs*
CO1	*PO1,PO2,PO3,PO4/PSO1*
CO2	*PO3,PO6,PO9,PO10/PSO1*
CO3	*PO2,PO3,PO4,PO6/PSO1*
CO4	*PO1,PO2,PO3,PO4,PO6,PO12/PSO1*
CO5	*PO1,PO3,PO6/PSO1*
CO6	*PO1,PO3,PO6,PO12/PSO1*

BMEE0173 VEHICLE DYNAMICS LAB

Credits:01 **L–T–P-J:0–0–2-0**

- Experimentalstudyofmechanismforairflowoverdifferentgeometryofvehicles.
- Experimentalstudiesofmeasurementsofdragandliftcoefficientfordifferentgeometryvehicleusingwind tunnel apparatus.
- Tostudytheeffectoftyrepressure andtemperatureontheperformanceofthetyre.
- Tosimulateand studyaquartercarmodelsusingMBDsoftware.
- Tosimulateandunderstandbehaviourofsprung/un-sprungmass&lumpedmasssystemMBDsoftware.
- Findingthestiffnessoftyrewithvariationofairpressure.
- Tosimulateand studythe effectofdifferentconditionson vehicleloading.
- Studyoflatesttechnologiesavailablenowadaysinvehicleshelpingtomaintainstability of thevehicleontheroad.
- Studygeometryofmotorcyclesaswellasvarioustypesofforcesfacedbythemotorcycle &its rider
- Studythelocation&heightofCentreofgravity(C.G)ofamotorcycle

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome:Attheendofthecourse,astudentwillbeableto

CO1.Thestudentwill beabletodeterminetheeffectsofairflow overdifferentgeometryofvehicles. (Apply)

CO2.The student will be able to determine coefficient of drag and lift for different vehicle geometrybyusingwindtunnel apparatus.(Analyze)

CO3.The student will be able to understand quarter car models and Behaviour of sprung / un-sprungmass&lumpedmasssystem.(Understand)

CO4.The student will be able to understand geometry of motorcycles as well as various types offorcesfacedbythemotorcycle&its rider.(Understand)

CO5.The student will be able to understand geometry of motorcycle and various forces effect onvehicleanditsrider. (Understand)

CO6.TheStudentwill beable to locateandfindheightofCentreofgravity (C.G)ofamotorcycle. (Analyze)

Mapping of Course Outcomes (Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs) :

COs	***POs/PSOs***
CO1	***PO2,PO3,PO4,PO6/PSO1***
CO2	***PO3,PO6,PO9/PSO1***
CO3	***PO1,PO2,PO4,PO10/PSO1***
CO4	***PO1,PO2,PO4,PO10/PSO1***
CO5	***PO1,PO2, PO3,PO4,PO6,PO12/PSO1***
CO6	***PO3,PO4,PO6,PO9/PSO1***

BMEE 0101: ADVANCED FLUID MECHANICS

Objective: *Aims to give Mechanical Engineering students a deeper and more thorough grounding in principlesand basic applications of fluid mechanics. Topics include: reviewof the conservation principles;constitutive relations of Newtonian fluid; Navier-Stokes equation; inviscid flow – inertial propertiesofvortex,2Dpotentialflows;viscousflow– basiclaminarflows,boundarylayertheories;introduction toturbulentflow –flow separation,sourcesofdrag.*

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Basic Concepts and Fundamentals:** Definition and properties of Fluids,Fluid as continuum, Langragian and Eulerian description, Velocity and stressfield, Fluidstatics,FluidKinematics **GoverningEquationofFluid Motion:**Reynoldstransporttheorem,Integral and differential forms of governing equations: mass, momentum andenergyconservationequations,Navier-Stokesequations,Euler'sequation,Bernoulli'sEquation. **Exact Solution of Navier – Stokes Equation:** Couette flows, Poiseuilleflows,Fullydevelopedflowsinnoncircularcross-sections,Unsteadyflows,Creepingflows. **Potential Flows:** Revisitof fluidkinematics,Stream andVelocitypotentialfunction, Circulation, Irrotational vortex, Basic plane potential flows: Uniformstream;SourceandSink;Vortexflow,Doublet,Superposition ofbasicplane potential flows, Flow past a circular cylinder, Magnus effect; Kutta-Joukowski lifttheorem;Conceptof liftanddrag.	20
II	**LaminarBoundaryLayer:**Boundarylayerequations,Boundarylayerthickness, Boundary layer on a flat plate, similarity solutions, Integral form ofboundarylayerequations,ApproximateMethods,Flowseparation,Entryflowintoa duct. **Turbulent Flow:** General equations of turbulent flow, Turbulent boundarylayer equation, Flat plate turbulent boundary layer, Turbulent pipe flow, Prandtlmixinghypothesis,Turbulencemodeling,Freeturbulentflows. **Compressible Flow:** Speed of sound and Mach number, Basic equations foronedimensionalflows,Isentropicrelations,Normal-shockwave,RankineHugoniotrelations,FannoandRayleighcurve,Machwaves,Obliqueshockwave, Prandtl-Meyerexpansionwaves,Quasionedimensionalflows,Compressibleviscousflows,Compressibleboundarylayers.	21

TextBooks:

- GuptaVijayandGuptaS.K.,"FluidMechanicsanditsApplications",WileyEasternLtd,1984.
- Som,S.K.&BiswasG.,"Introductionoffluidmechanics&FluidMachines",TMH,2000,2ndEdition
- Shames, I.H.,"MechanicsofFluids", McGrawHill, Int.Student,Education, 2016
- FrankM.White,ViscousFluidFlow,ThirdEdition,McGraw-HillSeriesofMechanicalEngineering,2006

ReferenceBooks:

- Fox W.Robert,McDonald T.Alan,Introduction toFluidMechanics,Fourth Edition,JohnWiley&Sons,1995
- MuralidharK.andBiswasG.,AdvancedEngineeringFluidMechanics,SecondEdition,Narosa, 2005.
- SchlichtingH.,BoundaryLayerTheory,SpringerVerlag,2000.
- McCormack,P.S.&Crane,L.J.PhysicalFluidDynamics, AcademicPress,1973

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Onlearningthissubject,studentswillbeableto:*

CO1:Apply thefundamentalsofkinematics,dynamicsandconservationlawsoffluidflowsystems.
CO2:Apply theprinciplesofhighand lowReynoldsnumberflowstofluidflowsystems.
CO3: Reviewtheconceptsofboundarylayerandflowin transition.
CO4:Apply thefundamentalsofturbulentflowtovariousfluidflowsystems.
CO5: Applythefundamentalsofonedimensional isentropicflowtovariablearea duct.
CO6: Analysetheconcept of normal shockformation and itseffects.
CO7:Applythe principlesofcompressible flowtoconstantareaductsubjectedtofrictionor heattransfer

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2/PS1
CO4	PO1,PO2,PO3/PS1
CO5	PO1,PO2/PS1
CO6	PO1,PO2,PO12/PS1
CO7	PO1,PO2,PO12/PS1

BMEE0102COMPRESSIBLEFLUIDFLOW

Prerequisites: *AdvancedFluidMechanics*

Objectives: *The objective of this course for post graduation students is to provide a solid background onthepertinentmathematical,physical,andengineeringconceptsthatmakeupthefoundationsof thecompressible flows.*

Credits:04 **L-T-P:3:1:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**BriefReviewofFluidMechanicsandThermodynamics:**Introduction,Dynamics Lawsofmotion,Kinematics,Equationofmotion,Reviewofthermodynamics, concepts of entropy and vorticity, Ideal gases, Special formsof the governing equations, Transport properties. **Physical Acoustic & Natureof Steady Compressible Fluid Introduction,**Onedimensionwavemotion,Transportofenergy& momentum, propagation of sound in duct, Machnumber,InviscidEnergyequation,PotentialFlow,Isentropicflow.**OneDimensional Steady Flow:** Introduction, Isentropic flow of perfect gases induct,Flowwithfriction,Flowwithheataddition,Flowwithfrictioninaconstantarea pipe.	25
II	**OneDimensionalUnsteadyFlow**:Shock conditions, the properties ofshock waves, weak & strong shockapproximation, Characteristicequationsfor homentropic &isentropicflow, Method of characteristics,piston analogy, Detonations and deflagrations. **Two Dimensional Steady Flow**Prandtl-Mayer function, Method of characteristics, Obliqueshocks,shockpolar,Reflectedandintersectingshocks,expansion waves,Curvedshocks,Nozzledesign,Linearizedpotentialflow,thinairfoilandslenderbodytheories,Conicalflow,Transonicflow.**ViscousEffects&AnalogsofCompressibleFlow**:Compressibleboundarylayers,Shockthickness,Shockwave-boundarylayer interactions, Shallow water flow, Trafficflow, Electro-acousticalanalogy	25

TextBooks:

- *BalachandranP.,FundamentalsofCompressibleFluidDynamics,PHILearning.2006*
- *RathakrishnanE.,GasDynamics,PHILearning,2014*
- *YahyaS.M.,FundamentalsofCompressibleFlowwithAircraftandRocketPropulsion,NewAgeInternationalPublishers,2003*

ReferenceBooks:

- *Anderson,Moderncompressibleflow,3eMcGrawHillEducation,2012.*
- *Shapiro,DynamicsandThermodynamicsofCompressibleFlow –Vol1.,JohnWiley&Sons,1953*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome:Attheend ofthecourse, a studentwillbeableto

CO1. Formulate and solve problems in one -dimensional steady compressible flow including: isentropic nozzleflow, constant area flow with friction (Fanno flow) and constant area flow with heat transfer (Rayliegh flow).**(Analyze)**

CO2.Derivetheconditionsforthechangeinpressure,densityandtemperatureforflowthroughanormalshock. **(Apply)**

CO3. Determine the strength ofobliqueshockwavesonwedgeshapedbodiesand concavecorners. **(Determine)**

CO4.Understandthevariousmeasuringinstrumentsusedincompressibleflow.**(Understand)**

CO5.Understandtheeffectofviscosity&analogyofcompressibilityon boundarylayerformation.**(Understand)**

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO5/PSO1
CO2	PO1,PO2,PO3/PSO1
CO3	PO2,PO3,PO3/PSO1
CO4	PO1,PO3,PO5/PSO1
CO5	PO1,PO3,PO5/PSO1

BMEE0103 AERODYNAMICS

Objective:

Students will be able to understandthe determination of forces, moments considering the thermal effects (heattransfers)on the bodies moving in a fluid.They will also learn the movement of wings or use of the wind force, thiswayitrequiresthecalculationstobedonefortheaerodynamicheatingoftheflightvehiclesandthehydrodynamic forcesapplied onthesurfaceofthevehicle.

Credits:04 **Semester** **L–T–P:3–1–0**

ModuleNo.	Content	Teaching Hours
I	**Introduction:**Airfoils,wingsandtheirnomenclature;lift,dragandpitching momentcoefficients;centerofpressureandaerodynamiccenter. Potential flow Analysis; Scalar and vector fields, velocity potential, line,surfaceandvolumeintegrals,circulationandliftgeneration,Kutta-Joukovskii theorem. Methodofsuperposition,thinairfoiltheory,sourceandvortexmethods. **Subsonic Flow:**Subsonic compressible flow past airfoils; Critical Machnumber, drag divergence Mach number, supercritical airfoils, effect ofsweep,area rule.	20
II	Fullandperturbationvelocitypotentialformulations;PrandtlandGlauertc ompressibilitycorrections. Transonic flow past airfoils, transonic similarity rules; Supersonic flowpastairfoils, linearized supersonic flow. Potentialflowoverliftingwing,liftinglinetheory,vortexlatticemethod, slender body theory, variation of lift and drag coefficients insubsonic flows with angle of attack, Reynolds number, thickness-to-chordratio. Supersonic flow over airfoils and wings; subsonic/supersonic leadingedge Hypersonicflows,Newtoniantheory,liftanddraginhypersonicflows	20

Books/References:

- Anderson.JD,Jr.,FundamentalsofAerodynamics,McGrawHill2001.
- L.M.Milne/Thompson,TheoreticalAerodynamics.
- Houghton,E.L.andCarpenter,P.W.,AerodynamicsforEngineers,Butterworth-Heinemann,2001.

OnlineEducation:

- MITOpenCourseware:MuddyPointAerodynamics.
- www.edx.org:AerodynamicsCourses:Problems&Assignments.
- https://www.grc.nasa.gov/www/k-12/airplane/presar.html

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

CO1 Aftercompletingthissubjectstudents willbeableto:
CO2.Definephysicalcharacteristicsofairandatmosphere.
CO3. Define basic aerodynamic forces acting on an aircraft and the factors affecting aerodynamic forces.CO4.Definegeometriccharacteristicsofairfoiland wing.
CO5.Explaintheeffects ofcamber,angleofattackandthicknessontheaerodynamiccharacteristicsofanairfoil.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	*POs/ PSOs*
CO1	*PO1,PO3,PO5/ PSO1,PSO3*
CO2	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO3	*PO1,PO2,PO3,PO4/ PSO1,PSO2,PSO3*
CO4	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO5	*PO1,PO3,PO5/ PSO1,PSO2,PSO3*

BMEE0104: TURBULENT FLOW

Pre-requisite: *Advanced Fluid Mechanics*
Objective: *Toprovideageneralintroductiontothephysicsandmathematicaldescriptionofturbulence;Toi ntroducethemethodsofanalysisusedinturbulencestudy,Tounderstandtheprinciplesofturbulencesimulati onandmodeling.*

Credits:4 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction**:Propertiesoflaminarflow,Propertiesofturbulent flow, Boundary Layer, Growth rate of Boundary layerfor LaminarandTurbulentFlows. **Characteristics of Turbulent Flow**: The Origin of Turbulence,NatureofTurbulence,SwirlingStructure,MeanMotion andFluctuations,ConsequencesofTurbulence,Homogeneous-IsotropicTurbulence. **CorrelationFunctions&KolmogorovHypothesis**:CorrelationFunctions,Ideasabouteddysize,IntensityofTurbulenceorDegreeof Turbulence,KolmogorovUniversalLawfortheFineStructure,EnergyCascade,KolmogorovLengthScale,Kolmogorov'sFirstHypothesis,Kolmogorov'sSecondHypothesis. **Reynolds'AveragedNavier-StokesEquations:**FurtheronLawsofAveraging,Reynolds'Decomposition,ExamplesofTurbulentFluctuations,andSomeMeasurementsonFluctuatingComponents. **Measurements on Fluctuating Components**: Shear Stress duetotheFluctuations,TheboundarylayermeasurementsofKlebanoff.	19
II	**Turbulent Boundary Layer Equations**: Turbulent BoundaryLayer Equationsforatwodimensionalflow. **ClassicalIdealizationofTurbulentStresses**:Introduction,TheBoussinesqor eddyviscositymodel,Eddyviscosity. **Vorticity Dynamics**: Introduction, Vorticity and the equationsof motion, Reynolds stress and vorticity, Vortex Stretching. TheVorticityEquation,VorticityinTurbulent Flows. **Dynamics of Turbulence**: Kinetic Energy of the Mean Flow,KineticEnergyofFluctuations,SomeScaling Relations. **The Law of the Wall for Wall Bounded Flows**: The Law of theWallforWallBoundedFlows,TheUniversalVelocityProfile, FreeShearFlows,TurbulentJets,UniformEddyViscositymodel.	21

TextBooks:
RJ.Garde,*"TurbulentFlow"*NewAge International PvtLtdPublishers

ReferenceBooks:
- StephenB.Pope,"*TurbulentFlows*",CambridgeUniversityPress
- H.TennekesandJ.L.Lumley,*"AFirstCourseinTurbulence"*,MITPress

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*At theendof thiscoursestudentswill beableto*

CO1.Understandthecharacteristicsofturbulentflow. (Understand)
CO2.ExplaintheCorrelationFunctions&KolmogorovHypothesis.(Understand)
CO3.UnderstandReynolds'AveragedNavier-StokesEquationsandTurbulentboundarylayerequation.(Understand)
CO4. Understand measurementoffluctuatingcomponentsandturbulentstresses.(Understand)
CO5.Understand VorticityandTurbulencedynamics.(Understand)
CO6.Understandtheconceptofwallbounded flows.(Understand)

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	PSO/PO
CO1	PSO1/PO1/PO2
CO2	PSO1/PO1/PO2/PO3
CO3	PSO1/PO1/PO2/PO3
CO4	PSO1/PO1/PO2/PO3
CO5	PSO1/PO1/PO2
CO6	PSO1/PO1

BMEE0105: COMPUTATIONAL FLUID DYNAMICS

Objective: *TheobjectiveofCFDistomodelthe continuousfluidswithPartialDifferentialEquations(PDEs)anddiscretizePDEsintoanalgebraproblem(Taylorseries),solveit,validateitandachievesimulationbaseddesign.*

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** What is CFD, How Does A CFD Code Work, Applications of CFDandProblemSolvingWithCFD. Classification of Physical Behavior, The Role of Characteristics in HyperbolicEquations,ClassificationMethodforSimplePartialDifferentialEquation,Classification of Fluid Flow Equations, Auxiliary Conditions for Viscous FluidFlowEquation. **ConservationLawsofFluidMotionandBoundaryConditions:**Stresstensoroveracontrolvolume,EiensteinIndecies,KronwerDeltaConcept,GoverningEquationsofFluidFlow,EquationofState,Continuityequation in Cartesian coordinate, polar coordinate and spherical coordinatesystem,Navier – Stokes Equations for A Newtonian Fluid, Conservative Formof the Governing Equations for Fluid Flow, Differential and Integral Forms ofthe GeneralTransport Equation,Applicationsof NavierStokesequation ofmotion-Flowthroughpipe, flowbetweentwoparallelplatesetc. **TurbulentFlow:**Turbulence,typesofturbulence,continuityequationforturbulentflow.Navierstokesequationforturbulentflow.Reynoldsstresstensorfor turbulentflow **Turbulence and Its Modeling** Turbulence Models Such as Boussinesquemodel, Mixing Length Model, application of mixing length model, Von-Karmanturbulencemodel,applicationofVon-Karmanturbulencemodel,TheK–ƐModel,ReynoldsStressEquationModels.	20
II	**Potential Flow:** Source flow, Sink flow, Doublet, flow past a half body,flowovercylinder, pressure distribution. **The Finite Volume Method for Diffusion Problem:** Introduction, FiniteVolumeMethodforSteadyStateDiffusion,WorkedExamples:OneDimensionalSteadyStateDiffusion, **TheFiniteVolumeMethodforConvection–DiffusionProblem:**Introduction, Steady One Dimensional Convection and Diffusion, The CentralDifferencingScheme,PropertiesofDiscretisationScheme,TheUpwindDifferencingScheme,TheHybridDifferencingScheme,Propertiesof discretisationscheme.	20

TextBooks:

- AndersonJ.,"*ComputationalFluidDynamicsAnIntroduction*",IIIEdition,Springer,2009.

ReferenceBooks:

- ZikonavOleg,"*EssentialComputationalFluidDynamics*",JohnWiley&Sons,2010.
- BlazekJ.,"*ComputationalFluidDynamics:PrinciplesandApplications*",IIEdition,2009,ElsevierLtd.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Studentsareexpectedtolearn:*

CourseOutcomesOncompletionofthis course,thestudentswillbeableto

CO1. Understand the Mathematical application used in CFD tools and techniques for effective designs ofstructuredgrid.

CO2. Apply modeling techniques to all the fluid dynamics, solid dynamics problems with respect to Multi-Disciplinary Industry.

CO3. Classify various computational methods for grid generation and its importance of efficient grid.CO4.FormulateunstructuredgridusingvariousmethodsbyconsideringdifferentboundaryconditionsCO 5.SimulatesimpleCFDmodelsand analyzeitsresults.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	*POs/PSOs*
CO1	*PO1,PO3,PO5/ PSO1,PSO3*
CO2	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO3	*PO1,PO2,PO3,PO4/ PSO1,PSO2,PSO3*
CO4	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO5	*PO1,PO3,PO5/ PSO1,PSO2,PSO3*

BMEE0184: MACHINE DRAWING LAB

Objective: *Students have an ability to apply knowledge of Modeling, science & engineering. Student can modelthis drawing even in CAD/CAM software by applying the basic knowledge of machine drawing. Students will ableto demonstrate an ability to design and conduct experiments, analyze and interpret data and assembly anddisassemblydrawingsknowledgewillbeprovided.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**OrthographicProjections**(1drawingsheet) Principleoffirstangleandthirdangleprojection,drawingofmachineelementsinfirst angleprojection, selectionof views, sectionalviews. **Screwedfasteners**(2drawingsheet) Threadnomenclature,Formsofthread,Threadseries,designation,Representation ofthreads,Boltedjoints,Lockingarrangementsofnuts,Foundationbolts. **Keys, Cotter Joint and Pin joint** (1 drawing sheet)Typesof keys,CotterjointorKnucklejoint. **Shaft Couplings** (1 drawing sheet)Rigid Coupling or Flexible coupling.**Rivetedjoints**(1drawings heet) Typesofrivetheads,Typesofrivetedjoints,Boilerjoint. **AssemblyDrawing** (1drawingsheet) Engine parts-stuffing box, cross head, Assembly drawing of eccentric, lathe tailstock,airvalve, screwjack, connecting rodsafetyvalveetc. **Freehandsketching** (sketchsheet) Free handsketchingoffoundation bolts,studs,pulleys,couplings,helical gear,bevelgear, crank,connecting rod, beltpulley, pistonetc. **ProductionDrawing** (2drawingsheets) Types,Examplesofsimplemachineelementslikehelicalgear,bevelgear,crank,con necting rod, beltpulley, pistonetc. **ComputerAidedDrafting**(2drawings) Introduction, input, output devices, introduction to software like AutoCAD,Pro-E, basic commands and development of 2D and 3D drawings of simpleparts.	24

TextBooks:

- DhawanR.K,'AText BookOfMachineDrawing': SChand & CompanyPvt.Ltd.NewDelhi,2018.
- Agrawal&Agrawal,C.,'EngineeringDrawing' :TataMcGrawHill,2017.

ReferenceBooks:

- JohnK.C.,'AText BookOfMachineDrawing':PHILearningPrivateLtd.NewDelhi,2010.
- DhawanR.K,'ATextBookOfMachineDrawing':SChand & CompanyPvt.Ltd.New Delhi,2018.
- JunnarkarN.D 'MachineDrawing':Pearson India,2006.

- Agrawal&Agrawal,C.,'EngineeringDrawing' :TataMcGrawHill,2017.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Afterstudyingthissubjectstudents willbeableto:*

CO1:AnalysiscomplexdesignsystemsrelatedtoMechanicalEngineering.
CO1:Drawtheassemblyfromtheindividualpartdrawing.
CO3:Improvetheirunderstandingofmachinedrawing,whichincludesclearvisualizationofobjects.
CO4:Enhancetheirproficiencyinreadingandinterpretingawidevarietyofproductionandassemblydrawings.
CO5: Improve their understanding of drawings of assembled views for the part drawingsusingconventions andeasy drawing proportions.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/ PSO1
CO2	PO1,PO3/PSO1
CO3	PO3/ PSO1
CO4	PO3,PO10/PSO1
CO5	PO3,PO10/PSO1

BMEE0201 COMPUTER AIDED DESIGN

Pre-requisite:*MachineDesignII*

Objective:

- *TounderstandtheuseofInformationtechnologyintheDesignProcess.*
- *Tounderstandtheautomationofdesignprocess.*
- *TounderstandtheintegrationofCAD/CAMsystem.*
- *Tounderstandtheconceptofnumericaltechniqueinautomationofdesign.*

Credits:03 **L–T–P:3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:**IntroductiontoDesign,Elements/RequirementsofCAD,IntroductiontoCAEandCIMS,Necessity&ItsImportance,EngineeringApplicationsof CAD **ComputerGraphics-I** CADSystems,GraphicsInputDevices,OutputDevices,GraphicsDisplay Devices-CRT, LCD, LED, Touch panel display, Plasma Display,Virtual Display. Graphicsdisplay technique:- Random & Raster ScanDisplayGraphicsStandards,Animationandmultimedia,GraphicsFunctions,RasterizationofOutputPrimitives:LineDrawingAlgorithm,CircleGeneratingAlgorithm, **ComputerGraphics–II:-** Coordinate Representation, Windowing and Clipping, Object modeling.Geometric Transformations (2D/3D) - Translation, Scaling, Shearing,Rotation&ReflectionMatrixRepresentationandconcatenation. Candidatemustbesubmitonemini-projectbasedonComputergraphics-I andII. **Geometricmodelingofcurve:** PropertiesofCurveDesignandRepresentation,InterpolationVsApproximation.Parametricandnon-parametricrepresentationofCurves. Importance of Convex Hull. Parametric Continuity Conditions.Geometricmodelingofcurve:-HermiteCubicsplines,BezierCurves,BezierCurves.IntroductiontoNubCurve.IntroductiontoSurfacerepresentation.	20

II	**SolidModelling:-** Surfacefitting:Beziersurfacepatchmodel,B-splinesurfacepatchmodel,QuadricandSuper-quadricSurfaces. SolidModellingapproaches:-PolygonMeshRepresentations,BoundaryRepresentation,ConstructiveSolidGeometry,BlobbyObjects,Sweeping, Loftingandothermodelingmethods **Animationsystem:-** Animationsystem,animationtechnique,Softwareusedtoperformanimation. **Application of Numerical method in Automation of design:**Application,algorithmandprogramoffollowingnumericaltechnique:Rootfindingmethod:-N-Rmethods,Bi-sectionmethod. Interpolation:Newtonforwardandbackwardinterpolation,Lagrangeinterpolation.NumericaldifferentiationusingNewtonforwardand backwardformula.NumericalIntegration. **IntroductiontoFiniteelementanalysis:** IntroductionClassificationofDifferentialEquations,VariationalFormulationApproach,RitzMethod,GeneralizedDefinitionofAnElement, Element Equations From Variations, Introduction, Principlesof Finite Elements Modeling,Stiffness Matrix/Displacement Matrix.Stiffness Matrix for Spring System, Bar & Beam Elements,Bar Elementsin2DSpace (TrussElement) **ApplicationSoftware**:ApplicationCommandsforDraftingsoftware	20

TextBooks:
- *I.Zeid,"CAD/CAM:TheoryandPractices":TataMcGraw-Hill.*
- *R.KSrivastava,"ComputerAidedDesign":UmeshPublication.*

ReferenceBooks:
- *P.NRao,"CAD/CAM:Principlesandapplications":TataMcGraw-Hill.*
- *R.BPatil:"Computeraideddesign":Tech-MaxPublication.*
- *J.NReddy,"Introductiontofiniteelementmethods":TataMcGraw-Hill.*
- *B.s.Grewal,"NumericalMethod":KhannaPublishers,2010.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:**Aftercompletionofthecourse,studentwillbeableto:**

CO1: Understand that the computer is not only a tool of visualization but also a tool forautomationofdesign.
CO2:Collaboratewithpeopleofdiversebackgroundsandabilities.
CO3:Identifythefactorsinthecomputeraidedprocessandproductdevelopment.CO4: Create the different wireframe primitives using parametric representations.CO5:Knowcomputeraideddesignconceptisnotlimitedto computerprograms.
CO6:Evaluatecomputeraideddesignmodelsandassembliesbasedoncriticalthinkingandproblemsolv

ing skills.
CO7:Communicateandpresentideasandsolutionstodesign problems.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO6,PO10/PSO3
CO2	PO1,PO12/ PSO3
CO3	PO2,PO4,PO11/,PSO3
CO4	PO5,PO6,PO9,PO11/PSO3
CO5	PO3,PO4,PO10,PO12/PSO3
CO6	PO3,PO5,PO7,PO8,PO12/PSO3
CO7	PO8,PO9,PO11,PO12/PSO3

BMEE0176 ADVANCED SOFTWARE LAB

Objective: *Toidentifytheroleofthesoftwareintoday'sDesignworld.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	• UseofPro/EngineerandPro/MechanicalSoftwareforExercisesin:DesignandAnalysisofMechanicalComponentDesignStudiedinSubjectsof MD-IandMD-II. • OptimizationofMechanicalDesignofComponentsandAssemblies. • ReverseEngineering ToolsandTheirUseinComponentDesign. • DesignAutomationandUserDefinedFeatures,AdvancedAssembly. • Structural,Welding,Surfacing,BehaviorModelerandOtherAdvancedModulesUseandDemonstrationof CaseStudies. • ApplicationofFiniteElementMethodstoElasticityProblemsandHeat TransferProblems.UsingANSYS, HYPERMESH,andFEMSoftware's.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COURSEOUTCOME: *AttheEndofthecourse,astudentwillableto:*

CO1.UnderstandtheconceptAutoCAD,Pro/EngineerandANSYS.(Understand)
CO2.DesignanddrafttheanyworkshoputilitytoolwithapplicationofAUTOCAD/ProE.(Design)
CO3.UnderstandtheconceptofdraftingofthetwodailyutilityobjectslikechairandpodiumusingProE/AUTOCAD.(Understand)
CO4.DesigntheFlywheelAssemblyusingProE/AUTOCAD.(Design)
CO5.UnderstandthefailureconditionofARCweldingjoint.(Understand)
CO6.UnderstandtheconceptofanalysisofShaftunderloadusing ANSYS.(Understand)

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO9/PSO1,PSO3
CO2	PO3,PO5,PO9,PO10/PSO1, PSO3
CO3	PO2,PO3,PO9/PSO1,PSO3
CO4	PO3,PO5,PO9,PO10,PO12/ PSO1,PSO3
CO5	PO2,PO3,PO4,PO6,PO9/PSO1,PSO3
CO6	PO2,PO3,PO9/PSO1,PSO3

BMEE0202CONTINUUMMECHANICS

Pre-requisite:*Strength of Materials*
Objective:*The aim of the continuum mechanics is to deals with the analysis of the kinematicsand the mechanicalbehaviorof materialsmodeled asacontinuous mass rather thanasdiscrete particles.*

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	Cartesiantensors.Thelinearelasticboundaryvalueproblem.Boundaryconditions.Naviersequations.Planewaves.Generalconservation laws for mass, momentum and angular momentum.**Deformationofacontinuum:**EulerandLagrangedescriptions,displacement vector, strain tensor, principal strains, compatibilityequations.	20
II	**The state of stress in a continuum:** stress vector, stress tensor,principalstress, equations ofmotion. **Constitutive equations:** isotropic and anisotropic linear elasticmaterials.Newtonianfluids:compressibleandincompressible fluids,Navier-Stokes equations.	20

TextBooks:

- P.Chadwick,"ContinuumMechanics:ConciseTheoryandProblems": Dover Publications,2012.
- J.W.Rudnicki, "Fundamentalsof ContinuumMechanics":WileyPublications,2014.

ReferenceBooks:

- Y.C.fung,"AFirst CourseinContinuumMechanics": Pearsonpublication,1993.
- W. M. Lai and D. H. Rubin, "Introduction to Continuum Mechanics": Butterworth-HeinemannPublication,2009.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Attheendofthecoursethestudentwillbeableto:*
CO1:Applythetensorformalism,
CO2:Analyzegeneralstressesanddeformationsincontinuousmaterials.
CO3: Formulateandsolvespecifictechnical problemsofdisplacement,strainandstress.
CO4: Numerically model and analyze the stresses and deformations of simple geometries under anarbitraryload inboth solidsand liquids.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3
CO2	PO2,PO3/PSO3
CO3	PO1,PO3/PSO3
CO4	PO1,PO3,PO4/PSO3

BMEE0203FINITEELEMENT METHODS

Pre-requisite:*ContinuumMechanics*

Course objective: *The objective of this course is to teach in a unified manner the fundamentalsofthefiniteelementmethodfortheanalysisofengineeringproblemsarisinginsolids, structuresandsomebasicthermalengineering.Thecoursewillemphasizethesolutionofreal life problems using the finite element method underscoring the importance of the choiceof the proper mathematical model, discretization techniques and element selection criteria.Finally, students will learn how to judge the quality of the numerical solution and improveaccuracyinan efficientmanner byoptimalselectionofsolution variables.*

Credits:04 **L–T–P:3-1-0**

Module No.	Contents	Teaching Hours
1	**Introduction:** Finiteelementmethodasanumericaltoolfordesign,Basicconcepts,Formulationprocedures,Historical development. **LineElementsandApplications:** Structural Problems: Linear and Quadratic elements, 1D Bar element,FormulationofTrusselement,Planetruss,Euler–Bernoullibeamelementformulation. ThermalandFluidProblems:Steadystateheattransfer:Elementformulations, treatment to boundary conditions with application to 1-Dheatconduction,heattransferthroughthinfins;Potentialflowproblems **2D Elements**: Triangular (CST, LST): Shape function, Jacobian matrix,strain-displacementmatrix,stress-strainrelationshipmatrix,forcevector. QuadrilateralElements(Q4,Q8):Shapefunction,Jacobianmatrix, strain-displacementmatrix,stress-strainrelationshipmatrix,forcevector.	20
2	**Application to Field Problems**: Thermal problems, Torsion of Noncircular shafts, Plane stress, plane strain and axisymmetric problems – Bodyforcesandtemperatureeffects,Stresscalculations,Plateandshellelements **DynamicProblems:**Formulationofdynamicproblems,consistentandlumped massmatrices for1-D and2-Delement, Solutionofeigenvalue1-Dproblems-Longitudinalandtransversevibrationofbeamswithallpossibleboundary conditions:Transformationmethods,Jacobimethod,VectorIterationmethods, subspaceiterationmethod.Solutionto1DtransientHeattransferproblems.	20

TextBooks

- T. R. Chandrupatla, Finite Element Analysis for Engineering and Technology, UniversityPress,2018
- P.Seshu,TextBookofFiniteElementAnalysis,PHILearningPvt.Ltd.,2012
- J. N. Reddy, An Introduction to the Finite Element Method, McGraw Hill InternationalEdition,2005

ReferenceBooks

- S.S.Rao,TheFiniteElementMethodinEngineering,ButterworthHeinemann,2017
- K.J.Bathe,FiniteElementProceduresinEngineeringAnalysis,PrenticeHallofIndia,2007
- O.C.Zienkiewics,R.L.Taylor,TheFiniteElementMethod,VolI&II,McGrawHill,1967

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome:

CO1:Understandthebasictheoryoffinite-elementmethod.
CO2:Tounderstandtheuseofthebasicfiniteelementsforstructuralapplicationsusingtruss,beam,frame, and...
CO3:Understandtheroleandsignificanceofshapefunctionsinfiniteelementformulationsanduselinear, quadratic, andcubicshapefunctionsfor interpolation.
CO4:Understandtheformulationofone-dimensional,twodimensionalandthreedimensionalelements.
CO5:RecognizesourcesoferrorsinFEA.
CO6:todeveloptheabilitytogeneratethegoverningFEequationsforsystemsgovernedbypartialdifferential equations

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO1,PO2/PSO1
CO4	PO1/PSO1
CO5	PO5/PSO1
CO6	PO2,PO3/PSO1

BMEE0204VIBRATION&NOISE

Pre-requisite:_DynamicsofMachine_

Course objective:_The objective of this course is to have a clear understanding of vibrationsandmodellingofmechanicalsystems.Studentswillanalysefreeandforcedvibrationsand willdevelop mathematicaltechniquestomodelanddesignmechanical systems._

Credits:04 **L–T–P:3-1-0**

Module No.	Contents	Teaching Hours
I	**Introduction:**FreeandForcedVibrationsofSingleDegreeofFreedomSystem, Newton's Second Law, D'Alembert's Principle, Lagrange'sEquation, Types of Damping, Algorithmic Decrement, Equivalent ViscousDamping,Support Excitation. **Basic Vibration Control:** reduction at source, Active feedback control,VibrationIsolationandTransmissibility. Two Degree of Freedom Systems: Free and Forced Vibrations With andWithoutDamping,PrincipleandNormalModes,VibrationAbsorbers. **Multi Degree of Freedom Systems:** Various Methods of Analysis of MultiDegreeFreedomSystems,InfluenceCoefficients,CouplingofModes,Rayleigh'sMethod, Dunkerley's Equation,Holzer'sMethod	22
II	**VibrationofContinuousSystems:**WaveEquation,LongitudinalVibrationof Bars, LateralVibrationsof Beam. **PassiveVibrationControl:**Basics,designofabsorber,absorberwithidealspring,shockabsorber,isolators withstiffnessanddamping. **ActiveVibrationControl:**Basics,Piezoelectricmaterials,electrorheologicalfluids,magnetorheologicalfluids,Magneto-andElectrostrictiveMaterialsinVibrationControl. **VibrationMeasurement:**Basics,dataacquisition,IntroductiontoCondition Monitoringof Machinery,FFT analysisandfilters	20

TextBooks

- G.K.Grover,"MechanicalVibrations": NemChandandBros,2009.
- S.S.Rao,"MechanicalVibrations",AddisonWesleyPublishingCompany,1990.
- S.G.Kelly,"MechanicalVibrations,Schaum'sOutlines",TataMcGrawHill, 2008.

ReferenceBooks

- J.S.rao,"VibrationConditionMonitoringofMachines":TataMc-GrawHill,2006.
- D.J.Inman,"VibrationandControl":JohnWilley&SonsInc,2002.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Afterstudyingthissubjectstudentswillbeableto:*

CO1:Analyzethemathematicalmodelingofthetwodegreesoffreedomsystemsandexplainaboutthe workingprincipleof vibration absorber.
CO2:Computethenaturalfrequenciesandmodeshapesofamultidegreeoffreedomsystemandexplainthe modalanalysisof a vibratingsystem.
CO3:AbilitytouseLagrange'sequationsforlinearandnonlinearvibratorysystems.
CO4:Understoodtheparametersandvariablesofavibratingsystem.
CO5:Understoodtheconceptofnaturalfrequencyandhowtofinditforavibratingsystem.
CO6:Learntheprocessofvibrationmeasurementsandcontrol.

MappingofCourseOutcomes(COs)withProgram outcomes(POs)andProgram SpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3
CO2	PO1,PO2/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO2/PSO3
CO5	PO1,PO3/PSO3
CO6	PO1/PSO3

BME E0301 COMPUTER AIDED MANUFACTURING

Pre-requisite:ManufacturingScienceII

Objective:Acquirefundamentalunderstandingoftheprinciplesof CAM,includingCNCprogramming,conceptofCIM &Robotics.

Credits:03 **L–T–P:3–0–0**

Modu leNo.	Contents	Teaching Hours
I	**Automation:** IntroductiontoCAM;AutomatedManufacturingSystem;Automation,NeedofAutomation,BasicElementsofAutomation,LevelsofAutomation,AutomationStrategies,Advantages&DisadvantagesofAutomation,HistoricalDevelopmentandFutureTrends. **NCSystem:** Fundamental of Numerical Control, Elements of NC Machine Tools, Classification ofNC MachineTools, Advantages, Suitability andLimitations of NC MachineTools,ApplicationofNCSystem,MethodsforImprovingAccuracyConsideringtheFactorsSuchasToolDeflectionandChatterandProductivity.ToolingofNCMachines.ConfigurationofCNC,DNCandAdaptiveControl. **NCPartProgramming** (A) Manual (Word Address Format) Programming. Examples Drilling, Turning andMilling;CannedCycles,Subroutine,andMacro. (B) APTProgramming.Geometry,MotionandAdditionalStatements,Macro-Statement.	20
II	**SystemDevices:** Feed Back Devices, Counting Devices, Digital to Analog Converter and Vice Versa.Interpolatorslike Digital Differential IntegratorLinear, CircularComputerAidedInspection(CAI)andComputerAidedTesting(CAT). **ComputerIntegratedManufacturingSystem** Concept of ComputerIntegratedManufacturingSystem, Impact of CIM on personnel,Role ofmanufacturingengineers, CIMWheel tounderstand basicfunctions. GroupTechnology,FlexibleManufacturingSystem,CAD/CAM,ComputerAidedProcessPlanning-Retrieval andGenerative,ConceptofMechatronics. **Robotics** Robot Anatomy, Laws of Robot, Human System and Robotics, Coordinate system,SpecificationsofRobot.Powersources,actuatorsandTransducers,RoboticSensors,Grippers,RobotSafety,RobotProgrammingandRobotApplications.	20

TextBooks:

- KundraandRao,"*ComputerAidedManufacturing*",TMH,NewDelhi.
- Koren,"*ComputercontrolofManufacturingsystems*",TMH,NewDelhi.
- Koren,"*NCMachines*",TMH,NewDelhi.

ReferenceBooks:

- Groover Mikell P., "*Automation, Production Systems and Computer IntegratedManufacturing*",PrenticeHallPublishers.
- S.J.Martin,"*NCMachineTools*",TMH,NewDelhi.
- Groover,"*CAD/CAM*",PrenticeHallPublishers.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome*:Aftercompletionofthiscourse,theStudentswillbeableto:*

- *CO1:Understandtheneedofautomationanditsstrategiesusedfordevelopmentinmanufacturing.(Understand)*
- *CO2:DescribebasicconceptsofCAMapplicationandCIMwheel.(Remember)*
- *CO3:PrepareCNCprogramsformanufacturingofdifferentgeometriesonmillingandlathemachines.(Apply)*
- *CO4:Understandtheconceptofgrouptechnology,CIM,FMSandCAPPsystemusedinindustries.(Remember)*
- *CO5:DescribetheuseoffeedbackdevicesusedinCNCmachines.(Remember)*
- *CO6:IllustratethebasicpartsandnecessityofRoboticsysteminIndustries.(Understand)*

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	PO/PSO
CO1	PO3/PSO2
CO2	PO1,PO3/PSO2
CO3	PO1,PO6/PSO2
CO4	PO2/PSO2
CO5	PO1/PSO2
CO6	PO6/PSO2

BMEE0178CAD/CAMLAB

Objective: *ToStudyandacquireknowledgeonvariouscomputerbaseddesigningandmachiningoperationsinspecialp urpose machinesanditsapplications inreallife manufacture ofcomponentsintheindustry.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	TotalTENExperimentsaretoCarryOut.FIVEExperimentsEachFromCAD and CAM. **A. CADExperiments** • LineDrawingorCircleDrawingExperiment:WritingandValidationofComputerProgram. • GeometricTransformationAlgorithmExperimentforTranslation/Rotation/Scaling: WritingandValidationofComputerProgram. • DesignofMachineComponentorOtherSystemExperiment:WritingandValidationof Computer Program. • UnderstandingandUseofAny3-DModelingSoftwareCommands. • Pro/E/IdeaEtc.Experiment:SolidModelingofAMachineComponent • Writing A Small Program for FEM for 2 Spring System and Validation ofProgramorUsingAFemPackage. • RootFindingsorCurveFittingExperiment:WritingandValidationofComputerProgram. • NumericalDifferentiationorNumericalIntegrationExperiment:Writing andValidationof ComputerProgram. **B. CAMExperiments** • ToStudytheCharacteristicFeaturesofCNCMachine. • Part Programming (in Word Address Format) Experiment for Turning.Operation (Including Operations Such as Grooving and Threading) andRunningonCNCMachine. • PartProgramming(inWordAddressFormatorATP)ExperimentforDrillingOperation(PointtoPoint) andRunningonCNC Machine. • PartProgramming(in Word Address Formator ATP)ExperimentforMillingOperation(Contouring)and Running onCNCMachine. • ExperimentonRobotandPrograms. • ExperimentonTransferLine/MaterialHandling. • ExperimentonDifferencebetweenOrdinaryandNCMachine,StudyorRetrofitting. • ExperimentonStudyofSystemDevicesSuchasMotorsandFeedBackDevices. • ExperimentonMecatronicsandControls.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Uponsuccessfulcompletionstudentsshouldbeableto:*

CO1:Useanunderstandingof GeneralandMachine(G&M)codetogenerateoreditaprogram.(Apply)
CO2:Understandtheuseof3-Dmodelsoftwarecommands.(Apply)
CO3:OperateCNClathe&CNCMillingmachines.(Apply)

CO4:UseAdditivemanufacturingequipment3Dscannerandprinter.(Apply)

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO3/PSO2
CO3	PO1/PSO2
CO4	PO5/PSO2

BMEE 0192 PROJECT BASEDCAD/CAM LAB

Credits:02 **L–T–P-J:0–0–0-8**

Objectives

- To impart fundamental knowledge to students in the latest technologicaltopics on Computer Aided Design, Computer Aided Manufacturing andComputer Aided Engineering Analysis and to prepare them for taking upfurtherresearchinthe areas.
- Tocreatecongenialenvironmentthatpromoteslearning,growthandimpartsabilitytoworkwithinterdisciplinarygroupsinprofessional,industryandresearchorganizations.
- To broaden and deepen their capabilities in analytical and experimentalresearch methods, analysis of data, and drawing relevant conclusions forscholarlywritingand presentation.
- Toprovideguidancetostudentsfortheirchoicesinresearchandprofessionalcareeroutlookandtoencouragestudentstotakeupresearch.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcomes

Aftercompletionofthiscourse,studentswillbeableto

CO1:Apply/developsolutionsortodoresearchintheareasofDesignandsimulationinMechanicalEngineering.(Apply)

CO2:Model&Analyzemechanicalcomponentusing3-Dmodelsoftwarecommands.(Apply)

CO3:ProgrammingonCNClathe&CNCMillingmachines.(Apply)

CO4:IllustrateUseofAdditivemanufacturing.(Apply)

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO11/PSO2
CO2	PO3/PSO2
CO3	PO1/PSO2
CO4	PO4/PSO2

BMEE0302WELDING SCIENCE AND TECHNOLOGY

Pre-requisite:ManufacturingScienceI

Objective:*Toimpartthecomprehensiveinsightintovariousbasicandadvanced Weldingprocessesandtheir applicationto differentmaterials.*

Credits:03 **L–T–P:3–0–0**

Module	Contents	Teaching Hours
1	**Introduction:** Welding as compared with other fabrication processes, Importanceandapplicationofwelding,classificationofweldingprocesses,Health&safetymeasuresinwelding.WeldingPowerSources:PhysicsofweldingArcBasiccharacteristicsofpowersourcesforvariousarcweldingprocesses,Physicsof**Welding Arc:** Welding arc, arc initiation,arc efficiency, heat generation at cathodeandanode, Effectof shielding gasonarc,isothermsof arcsandarcblow. **Metal Transfer:** Mechanism and types ofmetal transfer in various arc weldingprocesses. **Weldability:** Effects of alloying elements on weld ability, welding of plain carbonsteel,CastIronandaluminium. **Welding Processes:** Shielded Metal Arc Welding (SMAW),TIG, MIG, Plasma Arc,SubmergedArcWelding,ElectrogasandElectroslag,FluxCoredArcWelding,Resistancewelding,	23
2	**Welding Processes (Contd…):**Friction welding,, Friction Stir Welding, Ultrasonicwelding,Explosivewelding,Laserbeam,welding,Electronbeamwelding,Underwaterwelding, Brazing,Soldering andBrazeweldingprocesses. **Heat Flow Welding:** Calculation of peak temperature; Width of Heat Affected Zone(HAZ); cooling rate and solidification rates; weld thermal cycles;residual stressesandtheirmeasurement;welddistortionanditsprevention. **Repair&MaintenanceWelding:**Hardfacing,Cladding,Surfacing,MetallizingprocessesandReclamationwelding. Micro&Macrostructuresinwelding. **Weld Design:** Types of welds & joints, Joint Design, Welding Symbols, weld defects,Inspection/testingofwelds,IntroductiontoWeldingProcedureSpecification&ProcedureQualificationRecord.	22

Text Books:

ParmarR.S.,“WeldingProcesses&Technology”,KhannapublishersNadkar
ni, S.V., “Modern Arc Welding Technology”, Oxford &
IBHCaryHobartB. ,“ModernWeldingTechnology”,PrenticeHall
Smit,Dave,“WeldingSkills”
Little R. “Welding technology”,Tata McGraw-
HillKearns, W.H.,“WeldingHandbook”Vol.3,
AWS,Miami

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcomes:

Studentsareexpectedtolearn:

Oncompletionofthiscourse,thestudentswould beableto:

CO1.Thestudentwillbeabletounderstandthefundamentalprinciples ofweldingprocesses.
CO2.Thestudent willbeabletoascertainthekeyparameters ofeachprocess,
CO3.Thestudent willbeabletoPredict thematerialbehaviourupon welding,
CO4.ThestudentwillabletoDesignappropriatePreandpostweldingHeattreatments(PWHT).

CO5.ThestudentwillabletounderstandInspection/testingofwelds,ProcedureSpecification&ProcedureQualificationRecordetc.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO4 / PSO2
CO4	PO5 / PSO2
CO5	PO3 / PSO2

BMEE0185 WELDING SCIENCE AND TECHNOLOGY LAB

Pre-requisite:*Manufacturing Science -I Lab*

Objective*:This course introduces thefundamentalslatest techniques and procedures forbeginning to advanced welding processes, The Course will provide hands on training weldingtheorytrainingtopics,weldjointsandpositions,weldingsafety,weldandbasemetalnomenclature, defects, inspection criteria, weld techniques and troubleshooting. Sample workwill undergo inspection as part of testing to ensure that they conform to American WeldingSociety(AWS).*

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Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
1	**ListofExperiments:** **1.** Welding Groove preparation as per the American WeldingSociety(AWS)Code **2.** ButtandlapJointpreparationbyShieldedMetalArcWelding (SMAW)process. **3.** TopreparebuttandlapjointbyGasTungstenArcWelding (GTAW)process **4.** Toprepare buttandTjointbyGas WeldingProcess(Withvarying Flame). **5.** TopreparebuttjointbySubmergedArcWelding(SAW)process. **6.** HAZmicrostructuralanalysisusingopticalMicroscope **7.** ComparisonofHardnessinFusionZone(FZ),HeatAffectedZone(HAZ)andParentmetalofarcweldment. **8.** SheetMetalfabricationUsingResistanceSpotWelding **9.** ImpactstrengthanalysisofweldjointthroughCharpyand Izod Test. **10.** FrictionStir weldingofAluminium alloys	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*
Outcome: Attheend ofthecoursethestudentwill beable

CO1. The student will be able to know the practical skills to weld in (flat,horizontal,verticalpositions,)usingthebasicweldingprocessesSMAW,GTAWetc.

CO2. The student will be able to know the basic fundamentals of *weldingprocessesandapplicationsandmetallurgy.*

CO3.The student will be able to know to develop basic know how andawarenessto dealwithpracticalaspectsofadvancedweldingandtheirmicrostructural analysis.
CO4.Thestudentwill beableto know aboutthemechanicalpropertiesand theirrequirementsforstructures.
CO5.Thestudentwillbeabletoknow differentadvancedjoiningoperations.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO4 / PSO2
CO4	PO5 / PSO2
CO5	PO3 / PSO2

BMEE0303 COMPOSITE MATERIALS

Pre-requisite:_MaterialScience_

Objective: *The objective for this course is to develop an understanding of the linear elastic analysis ofcomposite materials. This understanding will include concepts such as anisotropic material behaviorandtheanalysisoflaminatedplates.Thestudentswillundertakeadesignprojectinvolvingapplicati on of fiber reinforced laminates. Detailed study of biaxial strength theories of orthotropicmaterials are also of interest. Fundamentals of engineering constants, special cases of laminates areemphasized. The students are introduced to reinforced materials, their base materials, selection andapplications.*

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Composite Materials:** Classification of various compositematerials. Reinforcements: Fibers: fabrication, properties and applications ofglass fibers, boron fibers, carbon fibers, organic fibers, Kevelar fibers, ceramicfibers, metallicfibers(metallicglasses). **Particulates:**PropertiesandapplicationofSiC,Al_2O_3,Si_3N_4andTiCparticulates. **Matrix Materials:**Functionsof a Matrix,DesiredPropertiesof aMatrix,PolymerMatrix(ThermosetsandThermoplastics),Metalmatrix,Ceramic matrix, CarbonMatrix,GlassMatrixetc. **MetalMatrixComposites:**Solidstate,liquidstateandin-situfabrication techniques of MMCs, Discontinuous reinforcement of MMCs, Properties andapplicationsof MMCs.	20
II	**CeramicMatrixComposites:**Fabrication,propertiesandinterfacesinCMCs. Toughness of CMCs, applications of CMCs. Carbon Fiber Composites:Fabrication, propertiesandinterfaces. **MechanicsofCompositeMaterials:**Density,mechanicalproperties,predicati on of elastic constants, transverse stresses, and thermal properties.Mechanicsofloadtransferfrommatrixtofibers,relationshipbetweenen gineeringconstants,analysisoflaminatedcomposites. **Strength, Fracture and Design of Composites:** Tensile and compressivestrengthofcomposites,Fracturemodesincomposites,Strengthoforth otropic lamina, maximum stress theory, maximum strain criterion, maximum workcriterion.	20

TextBook:

- S.W.TsaiandH.T.Hahn, "IntroductiontoCompositeMaterials":TechnomicPublishingCo.,1980.
- A.K.Kaw,"Mechanicsofcompositematerials":CRCPress,1997.
- MukhopadhyayMadhujit,"MechanicsofCompositeMaterialsandStructures":UniversityPress, 2005.

ReferenceBooks:

- RoberM.Joness,“MechanicsofCompositeMaterials”:Mc-GrawHillKogakushaLtd,1975.
- MichaelW.Hyer,“StressAnalysisofFiberReinforcedCompositeMaterials”:MGHInternational,2009.
- KrishanK.Chawla,“CompositeMaterialScienceandEngineering”:Springer,1987.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*
Outcome: Aftersuccessfulcompletionofthiscourse,thestudentwillbeableto:

CO1: Understanding of smart materials, manufacturing processes, advantages and applications.

CO2: Identify and Evaluate the properties of fiber reinforcements, particulates, matrix materials and commercial composites.

CO3: Develop competency in one or more common composite manufacturing techniques and be able to select appropriate technique for manufacture of composite products.

CO4: Analyze and understand the mechanical properties and mechanics of load transfer from matrix to fibers.

CO5: Understand and predict the mechanical performance and failure behaviour of the composites.

CO6: Apply the knowledge of manufacturing methods and composite mechanical performance of a given composites design project.

CO7: To understand the different testing methods/ Characterization of smart materials.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO1/PO4/PO5/PSO1/PSO2/PSO3
CO3	PO1/PSO2
CO4	PO1/PSO1
CO5	PO1/PO4/PSO3
CO6	PO1/PO2/PSO2/PSO3
CO7	PO1/PSO2/PSO3

BMEE0304MODERNMANUFACTURING PROCESS

Objective:*In this course students acquire the ability to know and understand the advance machines andtheir operations. Students will be able to formulate problems in advanced metal cutting and evaluate thecuttingparameters,establishacompletesolutiontometalcuttingproblemsusingmathematicalorgraphicaltechniques.*

Credits:03 **L–T–P: 3–0–0**

Module	Contents	Contact Hours
1	**Introduction:** Types of advanced manufacturing processes; Evolution, need,andclassificationof advancedmachiningprocesses(AMPs). **MechanicalTypeMMPs:**USM,AJM,WJM,AWJMprocesses:Processprincipleandelements;Tooldesign;Mechanismofmaterial removal,parametricanalysis;Shape andmaterialapplications;Operationalcharacteristics;Limitations. **AdvancedSuperFinishingProcess:**Abrasive Flow Machining;MagneticAbrasiveFinishing;MagnetoRheologicalAbrasiveFinishing:Processprinciple, process equipment; Analysis and modeling of finishing mechanism;Parametricanalysis;Applications. **Chemical Type AMPs:** Process principle and details of Chemical Machining;Photo-ChemicalMachining,andBio-ChemicalMachiningprocesses.	21
2	**Electro Chemical Type AMPs:** ECM-Process principle, mechanism of materialremoval;KinematicsanddynamicsofECM;Toolingdesign;Choiceandanalysisof processparameters;Surfacefinishandaccuracy **Thermal Type AMPs:** EDM, LBM, EBM, IBM, PAM processes: Workingprinciple; Power circuits; Mechanism of material removal; Process parametersandcharacteristics;Surfacefinishandaccuracy:Shapeandmaterialsapplications,limitations. **Derived and Hybrid AMPs:** Introduction of processes like rotary ultrasonicmachining, electro stream drilling, shaped tube electro machining, wire electrodischargemachining,electrochemicalgrinding,electrochemicalhoning,electrochemicaldeburringandelectro-chemicalsparkmachining. **Misc.Topics:**Process selectionandprocessplanningforAMPs.	21

TextBook:

1. Mishra,P.K.,“NonconventionalMachining”,NarosaPublishingHouse.
2. Pandey, P.C.,andShan, H.S.,“ModernMachiningProcesses”, TataMcGraw-Hill.
3. Jain,V.K.,“AdvancedMachiningProcesses”,AlliedPublishers.
4. Benedict,G.F.,“NontraditionalManufacturingProcesses”, MarcelDekker.
5. McGeough, J.A.,“AdvanceMethodofMachining”,ChapmanandHall.
6. Ghosh,A.,andMallik, A.K.,“ManufacturingScience”, AffiliatedEast-WestPress.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:

Studentsareexpectedtolearn:

Oncompletionofthis course,thestudentswould beableto:

CO1.Thestudentwillbeabletoperformadvanceoperationsinmanufacturingprocesses.

CO2.Thestudentwillbeabletoapplyengineeringmathematicsto solvethebasicproblemsofmetalcutting.

CO3.Thestudentwillbeabletohavein-depthknowledgeofmachines,mechanismsandtheiroperationsformaterialremovalusingadvance machines.

CO4Thestudentwillbeabletoperformprocessselectionandplanningforadvancedmanufacturingprocesses.

CO5Thestudentwillbeabletounderstanddifferentoperationsofmanufacturingfordifferenttypesofmachinesandprocesses.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 /PSO2
CO3	PO3 /PSO2
CO4	PO5 /PSO2
CO5	PO4 / PSO2

BMEE0179 MODERNMANUFACTURING PROCESSLAB

Pre-requisite:*ManufacturingScience -ILab*

Objective*:Thiscourseintroducesthelatesttechniquesandproceduresforadvancedmanufacturing processes, The Course will provide hands on training of some manufacturingtheory training topics. Sample work will undergo inspection as part of testing to ensure thattheyconform tosetstandards.*

Credits:01 **L–T–P-J:0–0–2-0**

- TodeterminethemetalremovalrateofAJMprocessbycontrollingmachiningparameters.
- TodeterminetheMRRofUSMbycontrollingtheslurryflowratefrequencyandamplitude.
- TodeterminetheMRReffectofelectrolyteflowroleonMRRinECM.
- ToinvestigatethesurfaceroughnessofmachinedsurfacebyEDMundervariableparameter.
- To determine themetalremovalratebyEDMundercontrolparameter.
- TodeterminetheMRRofLBMbyvariableparameter& itseffectonmetalstructure.
- Todesign&manufactureacomponentby3Dprinting.
- ToinvestigatethemachinedzonebywirecutEDM.
- Tofabricate&studyahybridmachining setup (miniproject)

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheend ofthecoursethestudentwill beable

CO1. The student will be able to know the practical skills to work with differentmanufacturingmachines.
CO2.Thestudentwillbeabletoknow thebasicfundamentalsofsomeadvancedimportantmanufacturingoperations.
CO3.The student will be able to know to develop basic know how andawareness to deal with practical aspects of advanced manufacturing operations.CO4.Thestudentwill beableto know aboutthemechanicalpropertiesand theirrequirementsforvariousstructures.

CO5. The student will be able to investigate different modern manufacturingoperations.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO4 / PSO2
CO4	PO3 / PSO2
CO5	PO5 / PSO2

BMEE0193PROJECTBASEDMODERNMANUFACTURINGPROCESSLAB

Pre-requisite:_ManufacturingScience –IandIILabs_

Objective:_This course introduces thefundamentalslatest techniques and procedures foradvancedadvancedmanufacturingprocesses,TheCoursewillprovidehandsontrainingdifferen t manufacturing processes. Sample work will undergo inspection as part of testing toensurethattheyconfirm todifferentstandards._

Credits:02 **L–T–P-J:0–0–0-8**

1. Designandfabricationofmicroabrasivejet formachining brittlematerials.
2. Designandfabricationofselfcenteringtablevicefordrillingmachine.
3. Applicationofjust-in-timemanufacturestrategyinasmallscaleindustry.
4. Designandfabricationofdrilltooldynamometer.
5. Toeloadmeasuringdevice.
6. ApplicationofTaugchitechnique/designofexperimenttohelmentmanufacturingprocess.
7. Designandfabricationofgearcuttingattachmentforlathe.
8. Computeraidedfeatureextractionandcncpartprogramgenerationforrotationalparts.
9. Designandfabricationofmeltingpotforindirectarcfurnace.
10. Designandfabricationofprogressivedie.

Focus: _This course focuses on Employability/Skill development and aligned with CO's 1 and 2_

Outcome: Attheend ofthecoursethestudentwill beable

CO1.Thestudentwillbeabletoknow thepracticalskillstodesignandfabricatedifferentmanufacturingprocesses.

CO2.Thestudentwillbeabletoknowtoknowthebasicfundamentalsofdifferentmanufacturing processes.

CO3.The student will be able to know to develop basic know how andawareness to deal with practical aspects of advanced manufacturing processes.CO4. The student will be able to know about the programs developed to enhancetheworkingcapability.

CO4. The student will be able to know different advanced machining andmanufacturingoperations.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs / PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO3 / PSO2
CO4	PO3 / PSO2
CO5	PO4 / PSO2

BMEE0305 METAL FORMING ANALYSIS

Pre-requisite:*ManufacturingScienceI*
Objectives: *To make the students understand the mechanics of metal forming and their behavior undervariousmetalforming processes.*

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	Reviewoftwodimensionalstressandstrain,stateofstressinthreedimensions,Stresstensor,Invariants,Mohr'scirclefor3-dimensionalstateofstress, strain at a point-Mohr's circle for strain, Hydrostatic & Deviatorycomponents of stress, Elastic stress strainrelations.Elements of theory ofplasticity; Flow curve, True stress & true strain, Yield criteria for ductilemetals, Von Misses & Teresa yield criteria, combined stress tests. The yieldlocus,Anisotropyinyielding,Yield surface, levy-Misses, Prandtl-Reuss Stress-Strain relation, Classification offormingprocessesvariablesinmetalformingandtheiroptimizationAnalysisof deformation processes- Method based on homogeneous compression sliplinefieldtheory,Upperboundsandlowerbounds,Slabmethodofanalysis.	22
II	Flow stress determination, Hot working, Cold working, Strain rate effect,Friction and lubrication, Deformation zone geometry, Workability, Residualstress. Analysis of metal forming processes (only limited portion), Forging: Loadcalculationinplanestrainforging,Rolling:Forces&geometricalrelationshipinrolling,Rollingloadandtorqueincoldrolling,Von-Karmanworkequation,Extrusion: Analysisof extrusionprocess,extrusionpressure,Drawing: Drawingload	20

TextBooks:

- R.HWagoner,Metal FormingAnalysis,CambridgeUniversityPress
- G.W.Rowe,PrinciplesofIndustrial Metal workingprocesses,CBS publishersandDistributors
- B. L.Juneja,FundamentalsofMetal formingprocesses,Newageinternationalpublishers
- GhoshandA.K.Malik, ManufacturingScience, EastWestPress

ReferenceBooks:

- Johson&Mellor,VanNostrand: EngineeringPlasticity.
- Avitzur,McGrawHill:Metalworking.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:

Afterlearningthecoursethestudentsshouldbeableto:*CO1.Identifyvariousformingprocess;*
CO2.
Identifyanddeterminevariousyieldcriteriausedinformingprocess;CO3.Learn mechanicsofforgingprocesses;

CO4. Learn mechanics of extraction processes;CO5.Learn mechanicsof drawingprocesses.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs / PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO1 / PSO2
CO4	PO2 / PSO2
CO5	PO1 / PSO2

BMEE0305 METAL FORMING ANALYSIS

Pre-requisite:*ManufacturingScienceI*
Objectives: *To make the students understand the mechanics of metal forming and their behavior undervariousmetalforming processes.*

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	Reviewoftwodimensionalstressandstrain,stateofstressinthreedimensions,Stresstensor,Invariants,Mohr'scirclefor3-dimensionalstateofstress, strain at a point-Mohr's circle for strain, Hydrostatic & Deviatorycomponents of stress, Elastic stress strainrelations.Elements of theory ofplasticity; Flow curve, True stress & true strain, Yield criteria for ductilemetals, Von Misses & Teresa yield criteria, combined stress tests. The yieldlocus,Anisotropyinyielding,Yield surface, levy-Misses, Prandtl-Reuss Stress-Strain relation, Classification offormingprocessesvariablesinmetalformingandtheiroptimizationAnalysisof deformation processes- Method based on homogeneous compression sliplinefieldtheory,Upperboundsandlowerbounds,Slabmethodofanalysis.	22
II	Flow stress determination, Hot working, Cold working, Strain rate effect,Friction and lubrication, Deformation zone geometry, Workability, Residualstress. Analysis of metal forming processes (only limited portion), Forging: Loadcalculationinplanestrainforging,Rolling:Forces&geometricalrelationshipinrolling,Rollingloadandtorqueincoldrolling,Von-Karmanworkequation,Extrusion: Analysisof extrusionprocess,extrusionpressure,Drawing: Drawingload	20

TextBooks:

- R.HWagoner,Metal FormingAnalysis,CambridgeUniversityPress
- G.W.Rowe,PrinciplesofIndustrial Metal workingprocesses,CBS publishersandDistributors
- B. L.Juneja,FundamentalsofMetal formingprocesses,Newageinternationalpublishers
- GhoshandA.K.Malik, ManufacturingScience, EastWestPress

ReferenceBooks:

- Johson&Mellor,VanNostrand: EngineeringPlasticity.
- Avitzur,McGrawHill:Metalworking.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:

Afterlearningthecoursethestudentsshouldbeableto:*CO1.Ide ntifyvariousformingprocess;*

CO2. Identifyanddeterminevariousyieldcriteriausedinformingprocess;CO3.Learn mechanicsofforgingprocesses;

CO4. Learn mechanics of extraction processes;CO5.Learn mechanicsof drawingprocesses.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs / PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO1 / PSO2
CO4	PO2 / PSO2
CO5	PO1 / PSO2

BMEE0401INDUSTRIALENGINEERING

Objective:

- *Toenablethestudentsunderstandthedemandforecastingtechniquesandcosting.*
- *Toprovidestudentsaninsightintotheconceptsofindustrialengineeringandorganization.*
- *Tofamiliarizethestudentswithprinciplesofwork-studyandErgonomics.*
- *Tointroducestudentstovariousaspectsofplantdesignandmaterialsplanning.*

Credits:3 **L–T–P-J:3–0–0-0**

Module No.	Content	Teaching Hours
I	**IndustrialOrganization:**Concept,Scope,Objective,Functions,Techniques,&Role ofIndustrial Engineering. MeaningofProductivity,DifferenceBetweenProduction&Productivity,IndücesofProductivity,ReasonsofLowProductivity,Techniques to Improve Productivity. Types of Production, Plant Layout.**Demand Forecasting:** Demand variation, Factors influencing demand,JudgmentalForecast,Timeseries-Rollingaverage,WeightedMovingAverage,Exponentialsmoothing,casualforecast-Correlation,Linearregression,ForecastError. **WorkStudy:** Meaning &BenefitofWorkStudy, Method Study, Recording Techniques-Process Chart, Time scale chart,Flow&StringDiagram,Micro-MotionStudy,SIMOChart,Cycle&ChronoCycle Graph, Time Study- Performance Rating, Allowances, Computation of StandardTime,WorkSampling, PMTS. **MaterialHandling:**Introduction,Objectives,ElementsandPrinciplesofMaterial Handling. **QualityControl:**ProcessControl,SQCCharts,Single,DoubleandSequential AcceptanceSampling,QualityFunctionDeployment.	26
II	**Production Management:** Production Planning & Control, InventoryControl-TypesofInventory,CostAssociatedwithInventory,Deterministic Inventory Models, Inventory Control Techniques, Cost ofProduction,Brake-Even-Analysis. **AdvanceTopicsinProductionManagement:**TotalQualityManagement (TQM)- TQM Approach, Stages of implementation, TQMModel,JustInTime(JIT)Manufacturing–SevenWaste,BasicElements, JITPhilosophy,KanbanSyatem.	14

TextBooks:

- KhannaO.P.,“IndustrialEngineering&Management”,DhanpatRai&Sons.
- ShankerRavi,“IndustrialEngineering”,GalgotiaPVTLtd.
- TelsangMartand,“IndustrialEngineeringandProductionManagement”,S.Chand,New Delhi

- KoontzH.&DonnelC.O.,“PrincipleofManagement&AnalysisofManagementFunctions”,Tata McGrawHillCo.
- MooreJ.,“ManufacturingManagement”,PrenticeHallEnglewoolcliffs:NewJersey.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:*Onsuccessfulcompletionofthislab,thestudentswillbeableto:*

- *CO1:ApplyconceptsofIndustrialEngineeringinthefieldofdifferentindustries.*
- *CO2:UnderstanddifferentconceptsregardingOrganizationandProductivityinindustries.*
- *CO3:Anabilitytoidentify,formulates,andsolvesengineeringproblemsbyanalyzingandinterpretingdata.*
- *CO4:Planningandcontrollingofproductionsystemanduseofmodernforecastingandmanagementtechniquesfordifferenttypesofindustries.*
- *CO5:Anabilitytodesign,develop,implement,andimproveintegratedsystemsthatincludepeople,materials,information, equipment, andenergy.*
- *CO6: An understanding of professional and ethical responsibility, ability to use the techniques, skills, andmodernengineeringtoolsnecessaryforengineering practice.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**Pos/PSOs**
CO1	PSO2,PO1,PO6
CO2	PSO2,PO1
CO3	PO2,PO9
CO4	PSO2,PO2,PO11
CO5	PSO1,PO3
CO6	PSO3,PO3,PO6,PO8

BMEE 0402 PRODUCT DESIGN AND DEVELOPMENT

Objectives:

- *TostudythebasicconceptsofProductdesignandDevelopment.*
- *Tostudytheapplicabilityofproductdesignand developmentinindustrialapplications.*
- *Tostudythe keyreasonsfordesign orredesign*.

Credits:03 L–T–P:3–0–0

Module No.	Contents	TeachingHours (Approx.)
I	Classification/SpecificationsofProducts.Productlife cycle. Productmix,Introductiontoproductdesign,TheRoleandNatureofDesign,OldandNewDesignMethods,DesignbyEvolution.,DesignbyCraft,NeedBasedDevelopment,TechnologyBasedDevelopments,EconomicFeasibilityofDesign Concepts, Modern product development process,Innovativethinking, Morphologyof design. **Reliability:**ReliabilityConsiderations:ReliabilityAnalysisofSystems,BathTubCurve,ReliabilityofSystemsinSeriesand Parallel.FailureRate,MeanTimetoFailure(MTTF)andMeanTime BetweenFailures (MTBF).	20
II	**DecisionTheory:**DecisionMakingUnderConditions of Certainty, Decision Making Under Conditions of Uncertainty,DecisionMakingUnderConditionsofRisk,Maximum LikelihoodCriterion,VariationofExpectedValueCriterion. **Break-Even Analysis**: Fixed and Variable Costs, Assumptions ofBreakEvenAnalysis,UtilityofBreakEvenAnalysis,Limitationof BreakEvenAnalysis **Statistical Quality Control (SQC):** Advantages of StatisticalQualityControl,QualityControlCharts,TypesofControl ChartsSuch as X(Bar)and R Chart,P Chart andC Chart. **Technological Forecasting**: Characteristics and Importance ofTechnological Forecasting,DifferentForecastingMethods, **Patents&IPActs-**Overview, Disclosurepreparation.	20

TextBooks:

- Chitab A.K.&Gupta R.C.,"*ProductDesign&Manufacturing*",PHI(EEE).
- UlrichK.T,andEppingerS.D,"*ProductDesignandDevelopment*",TataMcGrawHill

ReferenceBooks:

- StarrM.K.,"*ProductDesign &Decision Theory*",PrenticeHall.
- CainC.D,"*EngineeringProductDesign*",BusinessBooks.

- MayallW.H.Itiffe,"*IndustrialDesignforEngineers*", TMH.
- J.ChristopherJones,"*DesignMethods–seedsofhumanfutures*",JohnWiley&Sons.
- JamesBoyle,JenniferJenkins,intellectualproperty:law&theinformationsociety-cases&materials,

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Studentswillbeable to:

CO1. Identifyand analyzetheproduct designanddevelopmentprocessesinmanufacturingindustry.
CO2.Definethecomponentsandtheirfunctionsofproductdesignanddevelopmentprocessesandtheirrelationshipsfromconcepttocustomeroverwholeproductlifecycle.
CO3.Analyze,evaluateandapplythemethodologiesforproductdesign,developmentandmanagement.
CO4.Decisionmakingabilityofthestudentswillimprove,theycantaketherightdecisionsregardingtheproductwithouttheproperinformation.
CO5.Undertakeamethodicalapproachtothemanagementofproductdevelopmenttosatisfycustomerneeds.
CO6. Carryoutcostandbenefitanalysisthroughvariouscostmodels.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs / PSOs
CO1	PO1 / PSO1
CO2	PO2 / PSO1
CO3	PO3 / PSO1
CO4	PO3 / PSO2
CO5	PO11/ PSO2
CO6	PO11/ PSO2

BMEE0403OPERATIONS RESEARCH

Pre-requisite:*IndustrialEngineering*

Objective:

- *ProvideknowledgeofOPTIMIZATIONapproaches*
- *TodevelopDecision-makingskills.*
- *Providescopetostudentstoresearchmethodsandlatesttrendsinoperationresearch.*
- *Tounderstandthevariousbusinesssituations.*

Credits:03 **L–T–P:3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:**BasicsofOperationsResearch,ApplicationArea,Models,AdvantagesandDisadvantagesofOperationsResearch. **LinearModels:** **Linear programming:** Problem Formulation, Graphical Method, SimplexMethod, Duality in LinearProgramming, Big M-Artificial Variable Method,Degeneracy. **AssignmentProblems:**MathematicalFormulation,HungarianMethodProblem, Degeneracyin Assignment Problem **Transportation:**Matrix Form, Basic Feasible Solution:- North west method,Leastcostmethod,Vogel'sapproximationmethod.OptimumSolution:-MODImethod,Unbalanced-Problems, **DynamicProgramming:**MultistageDecisionProblems&Solutions,PrincipleofOptimality. **Game Theory:**Two Persons Zero Sum Game, Solution With/Without SaddlePoint,propertyof Dominance,Graphical methods	20
II	**Sequencing:**Introduction,Assumption,Johnson'sProcedureforNJobsonTwo MachinesandNJobson ThreeMachines. **Simulations:** Simulation V/S Mathematical Modeling, Monte-CarloSimulation,SimulationLanguages,Uses,Advantagesand Limitations. **InventoryModels:**Variouscostandconcepts,EOQ,Deterministicinventorymodels-productionmodel-Buffer stock **QueuingModels**:Introduction,PoissonandExponentialDistribution,SingleServer andMultiServersModels. **Networks:**BasicConcepts,Constructionofnetworks,RulesforNetworkDrawing,CPMCalculations. Pert Calculations Such As Different Times and Different Floats.Casestudybased2 Miniprojects.	20

TextBooks:

- *GuptaPremKumar,HiraD.S.,"OperationsResearch":S.Chand&Co.*
- *Taha,HamdyA.,"OperationsResearch":PrenticeHallInternationalPublications.*

ReferenceBooks:

- *Wagner,Claire,"PrinciplesofOperationsResearch":PrenticeHallInternationalPublications.*

- *Buffa,Edwood,“ProductionPlanningofOperationManagement”:TMHPublications.*
- *Rao,S.S.,“OptimizationTechniques”:WileyEasternLimited.*
- *Pradeep.p.Pai,“OperationResearch”:OxforduniversityPress.*

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

Aftercompletion of thecourse,studentwillbeableto:

CO1:Toimpartknowledgeinconceptsandtoolsof OperationsResearch.
CO2:Applytheknowledge&toolsofoperationresearchinvariousindustries.
CO3:Proficienttorecognizetheimportanceandvalueofmathematicalmodeling in solving practical problems in industry by linear programmingproblems.
CO4: Understand the mathematical tools that are needed to formulate &solvetransportationproblems forcost optimization.
CO5: Understand the process of best strategy using decision making methodsunderuncertainty andgametheory.
CO6: Determine the optimum sequence of n job over 2 and 3 machining bysequencing.
CO7:Understandtheconceptofprojectnetwork,projectscheduleandproject monitoring activitiesby usingCPMand PERTmethod.

Mappingof CourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs)

COs	**POs/PSOs**
CO1	**PO1,PO2,PO6/PSO3**
CO2	**PO1,PO9/PSO3**
CO3	**PO2,PO11/PSO3**
CO4	**PO5,PO9,PO11/PSO3**
CO5	**PO3,PO4,PO10,PO12/PSO3**
CO6	**PO3,PO5/PSO3**
CO7	**PO8,PO11,PO12/PSO3**

BMEE0404 VALUE ENGINEERING

Pre-requisite:*IndustrialEngineering*

Objective

1. Understandtheimportanceofvalueengineeringanditsapplicationintheirrespectivefields
2. FamiliarizewiththeprocedureofValueanalysisandValueengineering
3. Implementationofvalueengineering.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	TeachingHours
I	**INTRODUCTION:** Meaning of Value Engineering (VE), Value and its types, Relationship between valuevis-a-visperson,timeandenvironment,HistoryofValueEngineering,ValueAnalysis,ValueMa nagement, Worldb odie sofValueEngineering&theiractivities, Multi-disciplinaryteamapproachinValueEngineeringstudy. **JOB PLANNING:**Introduction and comparison of jobplansin value engineering, FinanceandhumanrelationsinVE. **ORIENTATIONPHASE:**Trainingassociates in Value AnalysisandValueEngineering(VAVE).Differenttrainingandcertificationsavailabl einVAVE,Methodtoconduct VAVEstudies. **INFORMATIONPHASE**:InformationneededforVAVE,methodtocollectandanalyzeinfor mation,A B C Analysis,ParetoAnalysis,Breakevenanalysis. **FUNCTIONANALYSIS PHASE**:Breakdownitemintoelementsandsub-elements, Introduction to functions,practicesession,typesoffunctions(useandsellfunction),levelsoffunction(basicandsecondary),identifyvariousfunctions.	22
II	**FUNCTION ANALYSIS PHASE**: Elementsofcost,procedureforcostallocation,costallocationtofunction, concept of worth, process flow for determining worth, discussions on worth, meaning ofFAST, use of FAST, development history of FAST, different types of FAST. Ground rules of FAST,FASTdiagram **CREATIVEPHASE:**Definitionofcreativity,misconceptionsaboutcreativity and **EVALUATIONPHASE:**Selectioncriteria,feasibilityanalysis,weightedevaluationme thods,decisionmatrix. **RECOMMENDATIONPHASE**:Needforrecommendation,methodtomakepresentati on,impactanalysisandjustificationreport,implementationplan,presentationskills. **IMPLEMENTATIONPHASE**:Detaileddesign,verificationandvalidation,certificatio n,changeimplementation. **AUDITPHASE**:Needforaudit,typesofaudit,howtoaudit.	22

TextBooks:

- *LawrenceD.Miles,TechniquesofValueAnalysisandEngineering,3rdEdition,NewYork*
- *KR.Chari,Valueengineering,NPC,NewDelhi*

ReferenceBooks:

- *SSIyer,ValueEngineering:AHow-toManual,NewageInternationalPublisher-2"dedition009*
- *AnilKumarMukhopadhaya,ValueEngineeringMastermind:FromConcepttoValueEngineeringCer*

tification.SAGE,NewDelhi

- *Del.LYonker,Valueengineeringanalysisandmethodology,CRCpress,NewYork*
- *Dr.M.A.Bulsara,Dr.H.R.Thakkar,ProductDesignandValueEngineering,charterpublishers,1st edition2015.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

Aftercompletionofthecourse,studentwillbeableto:

CO1:ToimpartknowledgeinconceptsandtoolsofValueEngineering.
CO2:Applytheknowledge&toolsofValueEngineeringinindustries.
CO3:UnderstandtheDifferentphasesofvalueengineeringandtheirsequence.
CO4:Understandandapplythemethodsofjobplanning.
CO5:Analyzetheproductdesign&developmentbyapplyingconceptofvalueengineering.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program SpecificOutcomes(PSOs)

Cos	**POs/PSOs**
CO1	**PO1,PO2,PO6/PSO2**
CO2	**PO1,PO9,PO11/PSO2**
CO3	**PO1,PO3/PSO2**
CO4	**PO1,PO3,PO5,PO9/PSO2**
CO5	**PO2,PO3,PO11/PSO2**

BMEE0405SUPPLYCHAINMANAGEMENT

Pre-requisite:_IndustrialEngineering_
CourseObjectives:_Toimpartknowledgeandunderstandingtostudentson SupplyChainManagementanditsrelevancetotoday's businessdecisionmaking._

- _Develop an understanding of therole of supplychain in amarket-orientedsociety_
- _Examinethemajorfunctionsofsupplychain_
- _Provideanopportunityforcomprehensiveanalysisanddiscussionofkeycontemporaryissues_
- _andproblemsinsupplychainmanagement_
- _Examine the details of planning andcontrolprocesses insupplychainmanagement_

Credits:3 **L–T–P:3–0–0**

ModuleNo.	Contents	TeachingHours (Approx.)
I	**AppliedSupplyChainManagement:**Introduction,Definition, Objectives&Importanceofsupplychainmanagement,complexity&keyissues,Centralizedvs.decentralized systems, Drivers in SCM, SCM decisions andskills, Strategy formulation in SCM, , Bullwhip effect, Push-based,pullbasedsystems **Informationtechnologyinsupplychain:**Valueofinformation ,EnablingsupplychainthroughIT,Criticalbusiness processes and information systems -DBMS,benefits of ERPinformationsystem, RFID **StrategicSourcing:**Sourceevaluation,collaborativeperspective, Buyer-Supplier Relationship, Partner Selection,developofPartnership,importanceofinventory,imbalances,uncertainties,inventorycosts,inventory turnoverration	21
II	**Transportation decision:** Tradeoff, Modes ofTransportation,ModelsforTransportationandDistribution, Factors affecting Network Effectiveness, 3 PL advantages, Bar CodingVendoranalysismodel,CoordinatedSCM,ReverseVsforward supply chain, types of reverse flows, collaborativeSCM'sandCPFR,agilesystems,sourcesofvariability,characteristics,supplierinterface SupplyChainManagementandprofitability,qualitymanagement,masscustomizationandglobalization,ethical SupplyChains,e-businessandSCM,BalancedScoreCard,Benchmarking,Performance measurement	19

TextBooks:

- R P Mohanty,S.G Deshmuki "SupplyChainManagement" Biztantra, NewDelhi,2005

- ChopraandMeindl,SupplyChainManagement2007
- JanatShah,SupplyChainManagement,2016

ReferenceBooks:

- Bowersox,LogisticalManagement,Mc-GrawHill,2000
- SahayBS,SupplyChainManagementforGlobalCompetitiveness,MacmillanIndiaLtd.,New Delhi.
- ReguramG,RangarajN,LogisticsandSupplyChainManagementCasesandConcepts,Mac millanIndia Ltd., NewDelhi,1999.
- Coyle, Bradi&Longby, The Management of Business Logistics, 3rd Ed., WestPublishingCo.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Aftercompletionofcourse,thestudentwillbeableto:*

CO1:Become familiar with current supply chain management trends Understand and apply thecurrentsupplychaintheories,practicesandconceptsutilizingcaseproblemsandproblem-basedlearningsituations

CO2:Developasoundunderstandingoftheimportantroleofsupplychainmanagementintoday's businessenvironment

CO3:Learntouseandapplycomputer-basedsupplychainoptimizationtoolsincludingtheuseofselectedstate ofthe artsupplychainsoftwaresuitescurrently used inbusiness

CO4:Developandutilizecriticalmanagementskillssuchasnegotiating,workingeffectivelywithin adiverse businessenvironment, ethical decisionmakingand useofinformationtechnology

CO5:Demonstratetheuseofeffectivewrittenandoralcommunications,criticalthinking,tea mbuilding andpresentationskillsasapplied to businessproblems

CO6:Successfullycompleteacaseprojectconcludingwithawrittenandoralpresentation ofthefindings

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2/PSO3
CO2	PO1/PSO2,PSO 3
CO3	PO5/PSO3
CO4	PO8/PSO3
CO5	PO4/PSO3
CO6	PO3,PO4/PSO3

BMEE0406 APPLIED ERGONOMICS

Pre-requisite: *ProductDevelopment&Design*
Objective: *Theobjectiveofthiscourseistointroduceindustrialergonomicsandthevastapplicationofergonomics in industryand designresearch forproductsystem.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** DefinitionofErgonomics/HumanFactors.TheevolutionofErgonomics, reasons to use ergonomics, micro- and macro- ergonomics, performingergonomics,judging the effectivenessofergonomicsintervention. **HumanBody:** Humancapabilitiesandlimitationsintermsofengineering.Anthropometrical, Physiological,Psycho-socialconsiderationsinErgonomics. **Ergonomicsdesignmethodology:** Occupationalsafetyandstressatworkplace;Workstation design; Furniture and Environment factors affecting human performance;Designdevelopmentandusability evaluation. **OfficeWorkstation**: Theories of healthy standing and sitting, free posturing, ergonomicsdesignoftheofficecomputerworkstation. **Methods, Standards and Work Design:** Determination of work content, workstation,workmethods,andtimesrequiredforvariousoccupationaljobs/tasks.Designoftasks/jobs, workplace, and work environment to increase productivity, eliminate waste,anddecreaseoccupational injury/illness.	22
II	**Musculo-skeletalsystem**:Jointmotionstudy,Basicmodeloncalculationofbiomechanicalstressesonourbody. **Product Ergonomics:** Product ergonomics and design, design from the view point ofbiomechanics,Workpostureanalysis,staticanddynamicwork,thevisual,auditoryandthermal environment and their impact on design. design for the physically challenged.**Research technique:** Ergonomic data generation, interpretation and application ofstatisticalmethods.Caseanalysis. **Miniproject:** MiniProjectworkinvolvingergonomicdesignresearchforproductsystem.	18

TextBooks:

- M.S.SandersandErnestJ.McCormick:Humanfactors inengineeringanddesign,sixthEdi.McGraw-HillInternational Editions,1987.
- P.O. Astrand andK.Rodahl:Textbook of work physiology,McGrawHill,New York,1970.
- Konz SA & Johnson S. Work Design: Industrial Ergonomics. 6thEdition, Holcomb HathawayPublishers,2004.ISBN:1-890871-48-6

ReferenceBooks:

- R.SBridger, Introduction toErgonomics,McGraw-HillInc.,1995.
- G.SalvendyEd.,HandbookofHumanFactorsandErgonomics,JohnWileyandSons,1997.
- D.Chakrabarti,IndianAnthropometricDimensionsforErgonomicDesignPractice,NationalInstituteofDesign,Ahmedabad,1997.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Uponcompletionofthecourse,studentsshouldbeableto:*

CO1: Apply basic knowledge of physical ergonomics such as physical load, anthropometry, biologicalvariationandbiomechanics.

CO2:Explainandapplybasicknowledgeofcognitiveergonomicssuchasperception,memory,informationprocessing,attention,learning,decision-making,stress,mentalworkloadandmaltreatment,

CO3: Apply basic knowledge of physical factors affecting human beings in relation to light, lighting,sound andnoise,climateandvibrations.

CO4: Identify and relate factors affecting human performance in the interaction with products, analyseand reflect on the results of ergonomic analysis of product systems and draw conclusions and giverecommendationsforproductimprovement.

CO5:Presentacompletedergonomic analysisofproductandworkplace orallyandinwriting.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

Cos	POs/PSOs
CO1	PO3/PSO1
CO2	PO2/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1

BMEE0501ROBOTICS&FMS

Pre-requisite:*IndustrialEngineering*

Objective: *To introduce the foundations of robotics. Also, a course on Robotics must use one or more softwaretonotonlyvisualizethemotionandcharacteristicsofrobotsbutalsotoanalyser/synthesize/designrobotsfor agivenapplication.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**FundamentalsofRobotTechnology**: Robot definition, automation and robotics, Robot anatomy, Work volume, Drivesystems.Controlsystemsanddynamicperformance.Accuracyandrepeatability. Sensors and actuators used in robotics. Machine Vision, Robotconfigurations,Pathcontrol.Introductiontorobotlanguages.Applications;Types (Mobile,Parallel);Serial:Cartesian,Cylindrical,etc.;SocialIssues **Robot Kinematics**: Mapping, Homogeneous transformations, Rotation matrix,ForwardKinematics(DHNotation)andinversekinematics:Closedformsolution.**Robot Differential Motion:** Linear and Angular velocity of rigid link,Velocityalonglink,Maipulatorjacobian,Statics:Useofjacobian.	20
II	**Robot Dynamics:** Lagrangian Mechanics,LagrangianFormulationandnumericals.Dynamics,Newton-EulerRecursiveAlgorithm,Simulation.Euler-LagrangeEquationsofmotion/Anyoneotherformulation like using Decoupled Natural Orthogonal Complements (DeNOC)**Endeffectors**:Mechanicalandothertypesofgrippers.Toolsasendeffectors.Robotand effectorinterface. Gripperselectionanddesign. **ApplicationsforManufacturing.**Flexibleautomation.Robotcelllayouts.Machineinterference.Otherconsiderationsinworkcelldesign.Workcellcontrol, interlocks. Robot cycle time analysis. Mechanical design of robot links.Typical applications of robots in material transfer, machine loading/unloading;processing operations;assemblyandinspection.	20

TextBook:

- R.K.Mittal,I.J.Nagrath,“Robotics&Control”,TataMcGraw&Hills,2005.
- MikellPGroover,MitchellWeiss “IndustrialRobotics:Technology,ProgrammingandApplication”TataMcGraw&Hills,2009.
- S.K.Saha,“IntroductiontoRobotics”,2ndEdition,McGraw-HillEducation,NewDelhi,2014

ReferenceBooks:

- JohnJ.Craig;“IntroductiontoRoboticsMechanics&Control”,PearsonEducation,2004.
- RobertJ.Schilling,“FundamentalsofRobotics,analysis&Control”,PrenticeHall(I)P.Ltd.,2002
- MarkW.Spong,SethHutchinson,M.Vidyasagar“RobotModelingandControl”JohnWiley2ndEd
- JSrinivasan,R.V.Dukkipati,K.Ramji,“Roboticscontrol&programming”,Narosa.
- Ghosal,Ashitava,“Robotics:FundamentalConceptsandAnalysis,”OxfordUniversityPress,2006
- M.Murray,M.,Li,Zexiang,Sastry,S.S.,“AMathematicalIntroductiontoRoboticManipulation,”CRCPress, 1994
- Tsai,L.W.,“RobotAnalysis:TheMechanicsofSerial&ParallelManipulators,”Wiley1999

- Niku,S.B.,"IntroductiontoRobotics:Analysis,Systems,Applications",PrenticeHall,2001

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Uponcompletionofthecourse,studentsshouldbeableto:*

CO1:Understandthefundamentalsofrobottechnologyfunctionssuchasdynamicperformance ,Sensors and actuators used in robotics.

CO2:KnowledgeofMachineVision,Robotconfigurations,Pathcontrollanguages.CO3: Understand of Cartesian, cylindrical, spherical and various application in roboticsCO4:Knowledgeofmodelingforkinematicanddynamicsverificationofanyrobotstructureusingsuitablesoftware

CO5:Understandrobotdifferentialmotion, grippersandendeffectors

CO6:Understandofvarioussensors,FMSintegrationandprogrammingforlinearandnonlinearpathin roboticapplications

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PO3/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEE0182ROBOTICS&FMS LAB

Credits:01 **L–T–P-J:0–0–2-0**

Module No.	Content	Teaching Hours
I	• Developmentofmultiplesensorfusionuseinvariousroboticapplication • DemonstrationofarticulatedSCARA,PUMAandotherrobots. • DemonstrationofCartesian,cylindrical,sphericalandvariousapplicationin robotics • Virtualmodelingforkinematicanddynamicsverificationofany robot structureusingsuitable software • Forward, inverse kinematics and trajectory planning forPUMA, SCARA and Stanford using robotics tool box forMATLAB	12
II	• Studyof various sensors integration in roboticapplications • Programming for linear and non linear path using roboticapplication • Simulation of planner and spatial mechanism using multi bodydynamicssoftware. • Design,modelingandanalysisofdifferenttypesofgrippersand manipulators. • Tointroduceanddemonstrateflexiblemanufacturingsystem • TostudyandintegratevariousFMScomponentlikemachinesand actuators in differentapplication offactoryautomation • StudyandprogrammingofsensorsintegrationinvariousFMSapplications	12

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

***Outcome:* At the end of this course students will be able to**

CO1:Understandthefunctionsofmultiplesensorfusionuseinvariousroboticapplication.

CO2:KnowledgeofarticulatedSCARA, PUMAand otherrobots.

CO3:UnderstandofCartesian,cylindrical,sphericalandvariousapplicationinrobotics

CO4:Knowledgeofmodelingforkinematicanddynamicsverificationofanyrobotstructureusin gsuitablesoftware

CO5:Knowledgeofforward,inversekinematicsandtrajectoryplanningforPUMA,SCARAand Stanford usingrobotics toolboxforMATLAB.

CO6:Understandofvarioussensors,FMSintegrationandprogrammingforlinearandnonlinea rpathin roboticapplications

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO3/PO12/PSO3
CO3	PO1/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEE0196 PROJECT BASED ROBOTICS & FMS LAB

Credits:02 **L–T–P-J:0–0–0-8**

Module No.	Content	Teaching Hours
	• Study of DTMF Controlled Robot without Microcontroller: The mainaimofthisprojectistocontrolaroboticvehiclebygivingtheinstruction through mobile phone using DTMF technology. This canbeusedforsurveillancesystemsandindustrialapplications. • Study of Microcontroller Based Line Following Robot : This projectillustrates the concept of tracking or following the path specified to aroboticvehicleusingAVRmicrocontroller.ThisprojectusesIRsensorto detect thepath specified bytheuser. • Study of PC Controlled Human Detection Robot: This project aims todetect the humans through a robotic vehicle by using IR sensors andmicrocontroller unit. This project is very helpful in the time of earthquakesto detect the personnel. • StudyofMetalDetectorRobotUsingMicrocontroller:AMetaldetectorrobotis usefultosensethemetalsinthepathaheadofit.This will be necessary requirement in case land mines detection. Sothis project meets the requirement with simple microcontroller basedrobot. • Study of Obstacle Avoiding Robot: This is an autonomous intelligentrobotwhichisbuiltwithinfraredsensorstosensetheobstaclescomin g in the path of the robot and correspondingly changes thedirectionofthe robot. • StudyofAutomaticFireSensingandExtinguishingRobot:Thisproject aims to develop a multi flame sensor based fire fighting robot.If the fire takes place, the robot moves towards the fired area andstartssprinklingthewaterfrom waterpump attachedtoit. • StudyofAutomatedSystemDesignforMetroTrain:Thisisanautomated system for a metro train which announces the station nameand displays the relevant information when train arrives at particularstation.Inthis,RFIDtags areusedfortrackingthestationdata. • Study of Color Guided Material Handling Robot: The main idea of thisprojectistobuildacolordetectingrobotwhichseparatestheobjects thataremovingonaconveyerbeltinanindustry.Thisprojectuses	24

	MATLABtodevelopcolordetectivealgorithm. • Study of Arduino Based Smart Boat with Obstacle Detection: This is asimpleDIYprojectwhichhelps todesignaboatwithadditionalfeatureslikelight guidedcontrolandobstacledetection. • Study of Design of Microcontroller Based Edge Avoider Robot : Thisproject implements a robot which can avoid edge by detecting earlyandtakesfurtheractionintime.Thisprojectalsoincludespathfinding, obstacledetectionand linefollowercapabilities.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: At theend ofthiscoursestudents willbe able to

CO1:Understandthefunctionsofmultiplesensorfusionuseinvariousroboticapplication.

CO2:KnowledgeofDTMFControlledRobotwithoutMicrocontroller,PUMAandotherrobots.

CO3:UnderstandtheworkingofAutomatic FireSensingandExtinguishingRobot

CO4:Knowledgeofmodelingforkinematicanddynamicsverificationofstructureusingsuitable softwareforObstacle AvoidingRobot.

CO5:Knowledgeofforward,inversekinematicsandtrajectoryplanningforPUMA,SCARAand Stanford usingrobotics toolboxforMATLAB.

CO6:UnderstandthevarioussensorsandtheirapplicationsinMetalDetectorRobotUsingMicro controller.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO12/PSO2,PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO3
CO4	PO1/PO2/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEE0502:INDUSTRIALAUTOMATION&CONTROLSYSTEMS

Pre-requisite:*IndustrialEngineering*

Objective:*Introductiontotheconceptofindustrialautomation,scopeofautomationandstudyofsocio-economic effects. Introduction to the fluid power control and study of the different fluid power systems working.Introduction to the automated material handling system used in automated industry. Study of the workingprinciplemechatronics devicesanddifferenttypesofcontrollers.Introductiontothecontrolsystems*

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:**Concept and Scope of Industrial Automation, Socio-EconomicConsiderations,AndPneumaticLogicCircuits:Un-ComplementationAlgorithm. **Fluid Power Control:**Fluid Power Control Elements and Standard GraphicalSymbols for Them, Construction and Performance of Fluid Power Generators,Hydraulic&PneumaticCylinders-Construction,DesignandMounting,Hydraulic & Pneumatic Valves for Pressure, Flow & Direction Control, ServoValves and Simple Servo Systems With Mechanical Feedback, Simple HydraulicandPneumaticCircuits. **HighVolumeProductionSystems:**TransferDevices&Feeder,Classification, Construction & Application, Automated Flow Lines, Analysis ofAutomatedFlowLinesforReliabilityandEfficiency,AssemblySystems.	22
II	**Mechatronics:**MechanicalSystemInterfacing,SimpleMechatronicsDevices:Servo Motors, Stepping Motors, DC Motors, Analog / Digital Convertors.TypesandFunctionofControllers. Mathematical Modeling of Physical System and Concept of Transfer FunctionSystem.RepresentationThroughBlockDiagramandSignalFlowGraph. Time DomainResponseAnalysisUnderTransientInput&FrequencyDomainAnalysis Root - LocusTechniques,BodePlot.	18

TextBooks:

- Nagrath&Gopal"*ControlSystem*", McGrawHillEducation;4thedition,2012.
- MajumdarS.R.,"*PneumaticSystems*",TataMcGrawHill,2017
- SundaramK.Shanmuga,"HydraulicandPneumaticControls",SChand&Company;1stEdition2006
- JagadeeshaT,"HydraulicsandPneumatics",DreamtechPress,2019

ReferenceBooks:

- EspositoA., "*FluidPowerwithApplications*",PearsonEducationIndia;7thedition,2013
- Groover,M.P.,"*Automation,ProductionSystems&ComputerIntegratedManufacturing*",PearsonEducation;Fourthedition, 2016.
- NormanS.Nise, "*ControlsystemEngineering*"Willey,2018.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

CO1:UnderstandtheConstruction,DesignandMounting,Hydraulic&PneumaticValvesforPressure,Flow&DirectionControl,ServoValvesandSimpleServoSystemsWithMechanicalFeedback

CO2:Providehydraulicsolutionsfordesigningautomatedsystems.

CO3:UnderstanddeviseAssemblyautomatedsystemsusingfeeders,orienteersandescapementdevices

CO4:Understand the principle and construction of ServoMotors,SteppingMotors,DCMotorsandAnalog/DigitalConvertors.TypesandFunction ofControllers.

CO5:Designandimplementelectro-pneumatic/hydraulicsolutionsforautomatedsystems.

- ***CO6:Apply*** *the Mathematical Modeling of Physical System and Concept of Transfer FunctionSystem*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/ PSO3
CO2	PO1/ PSO3
CO3	PO1/ PSO3
CO4	PO4/ PSO3
CO5	PO1/ PSO3
CO6	PO1,PO4/PSO3

BMEE0504ENGINEERINGSYSTEMMODELLINGANDSIMULATION

Pre-requisite:*IndustrialEngineering*

Objective:*Tointroducethestudentsabouttheknowledgeofbasicanddynamicsystemmodelsofengineeringandsimulation system.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**BasicSystemmodels:**Mathematicalmodels,Mechanicalsystembuildingblocks, Electrical system building block, fluid system building block, thermalsystem buildingblock. **SystemModels:**Engineeringsystems,Rotationaltranslationalsystems,Electro-mechanicalsystems, linearity,HydraulicMechanicalsystems. **DynamicResponseofSystems:** Modellingdynamicsystems,Terminology,Firstordersystems,secondordersystems, performance measure of second order systems, system identification.**System Transfer Functions:** The transfer function, first order systems, second order systems, systems inseries,systemswithfeedbackloops,effectofpolelocationontransientresponse.	19
II	**Mechanical Event Simulation (Finite Element modelling and Analysis):**Introduction,Generalprocedureoffiniteelementmethod,finiteelementanalysis,iso-parametricevaluationofelementmatrices,finiteelementmodelling,meshgeneration,designandengineeringapplications.IntroductiontoProEsoftware-Mechanica&dynamicsimulation module. **SystemSimulation:** Introduction, Review of probability and statistics, managing the event calendarina discreteeventsimulationmodel,modellinginputdata. Generation of random numbers and variates, generic features and introductionto Arena Software, Real world applications of simulation, discrete continuoussimulation,verificationandvalidationofsimulation models.	19

TextBook:

- W.Bolton,“Mechatronics–ElectroniccontrolsystemsinMechanical&ElectricalEngineering”,PearsonEducationLtd.1868
- IbrahimZeid,“CAD/CAMTheoryandPractice”,TataMcGraw-HillPublishingCompanyLimited.1991
- SankarSengupta,SystemSimulationandmodelling, Pearson.2013

ReferenceBooks:

- Deo,Narsingh,MillicanCharlesE.,”SystemSimulationWithDigitalComputer”,PHI.1978
- Gordon,Geoffrey,SystemSimulation,PHI.1977
- P.Radhakrishnan,SSubramanyan,V.Raju,CAD/CAM/CIM,NewAgeInternationalPublishers.2008

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: *Uponsuccessfulcompletionofthiscourse,thestudentwillbeableto:*

CO1:Describetheroleofimportantelementsofdiscrete eventsimulationandmodelingparadigm.

CO2:Conceptualizerealworldsituationsrelatedtosystemsdevelopment decisions,originatingfromsourcerequirementsand goals.

CO3:Developskillstoapplysimulationsoftwaretoconstructandexecutegoal-driven systemmodels. Interpretthemodelandapplytheresultstoresolvecriticalissuesin arealworldenvironment.

CO4:UnderstandthenumericalmethodsinvolvedinFiniteElementTheory.

CO5:Understandtheroleandsignificanceofshapefunctionsinfiniteelementformulationsanduselinear, quadratic, andcubicshapefunctionsfor interpolation.

CO6:RecognizesourcesoferrorsinFEA.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1
CO6	PO5/PSO1

BMEO 0001TOTALQUALITYMANAGEMENT

Objective: *Study of total quality management will enable the students to develop their mental horizon byenhancing their knowledge and skills which will embed organizational skill & it would be overall beneficial for anyorganization. The main objective is to provide students with quality, organizational and people management skillsandtechniquestoenablethemtomakeasignificantcontributiontoanorganization'squalitypolicy.*

Credits:04 L–T–P:3–1–0

Module No.	Contents	TeachingHours
I	**Introduction:** Definition of Quality & Total Quality, World Scenario, QualityEducation, Drivers of Quality, Principles of Quality Management, Internal andExternal Customers, Vision, Mission, Objectives & Targets, Ten Principles ofQuality Management, Evaluation of TQM, Stages of Implementation of TQM, TQMModels. **Quality Planning:** SWOT Analysis, Strategic Planning, Organizational Culture,ManagementofChange. **CustomerOrientation:** Customer Focus,Customer SatisfactionModels,Customer Retention, Measurement of Customer Satisfaction, Quality FunctionDeployment. **QualitySolving Tools:** Process of Solving Problems – ConventionalMethods,7ModernManagementTools. **Continuous Improvement Strategies:** Deming Wheel, Zero Defect Concept,Benchmarking,SixSigma(6σ),Preventive Techniques–FailureMode&EffectAnalysis(FMEA),FiveSofHousekeeping,TimeManagement, TotalProductiveMaintenance	20
II	**Human Dimensions of TQM:** Top Management Commitment, Leadership forTQM, Motivational Strategies, Quality Circles, Team Development & Building,CommunicationandTransactionalAnalysis. **Quality Certification:** ISO 9000 Quality Management System (QMS), ISO14000Series,Qs9000Series,QualityAuditing,QualityAwards,QualityCertifyingAgencies,BusinessExcellenceModels. **Cost of Quality**- Prevention Cost, Appraisal Cost, Internal FailureCost,External Failure Cost, TQM Roadmap, How TQM Fails, TQM ImplementationStrategies. **ContributionofTQMGurus:**W.EdwardsDeming,JuranCrosby,Ishikawa,KaisenandTheirTheoriesforTotalQuality.	20

TextBooks:

- SuganthiL.,A.SamuelAnand,"TotalQualityManagement",PHILearning.
- BediKanishka,"QualityManagement",OxfordUniversityPress.

ReferenceBooks:

- JuranJ.M.,M.GrynaFranic,"QualityPlanningandAnalysis",TataMcGrawHillEdition.
- KumarS.,"TotalQualityManagement",UniversitySciencePress.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*
Outcome:*Attheendofthecoursethestudentshouldbeableto:*

CO1:Explainqualityconceptsregardingbasicandadvancedquality.

CO2:Describetools&techniques,qualitymanagementsystems,qualityexcellencemethodologies.
CO3:Explain continuous improvement methodologies, to the human development and motivation of peopleacross an organization.

CO4:DescribeISOqualitystandardusedinindustries.
CO5:Understandandexplainconceptofcostofquality.
CO6:Illustratecontributionof philosopherlikeDeming,CrossbyIshikawa&KaiseninfieldofTQM.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO4/PSO2
CO2	PO2/PSO2
CO3	PO1/PSO2
CO4	PO7/PSO2
CO5	PO2/PSO2
CO6	PO6/PSO2

BMEO0002ENERGYCONSERVATIONANDMANAGEMENT

Objective: *The main objective of this course is to understand the principles associated with effective energymanagement and to apply these principles in the day-to-day life. To gain exposure to energy auditing, to identifyenergy conservation opportunities in various industrial processes and to evaluate the performance of boilers,furnacesandotherenergyintensiveequipment/processes.*

Credits:04 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **INTRODUCTION:** Principles of energy management. Managerial organization,Functionalareasfori)manufacturingindustry,ii)Processindustry,iii)Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating,Organizingandmanaging energymanagementprograms **ENERGY AUDIT:** Definition and concepts. Types of energy audits, Basic energyconcepts,Resourcesforplantenergystudies.Datagathering,Analyticaltechniques.**EnergyConservation:**Technologiesforenergyconservation,Designforconservationofenergymaterials,Energyflownetworks.Criticalassessmentof energy usage. Formulation of objectives and constrains, Synthesis of alternativeoptionsandtechnicalanalysisof options.Processintegration.	23
II	**Unit-II** **ENERGYEFFICIENCY:**FuelsandCombustion-Boilers-SteamSystem-Furnaces -InsulationandRefractory-FBCBoilers-Cogeneration-Wasteheatrecovery,DieselGeneratingSystem. **ENERGYPERFORMANCEASSESSMENT:**EquipmentandUtilitysystems-Boilers-Furnaces-Cogeneration, Turbines (Gas, Steam)- Heat Exchangers-ElectricMotors and Variable Speed, Drives-Fans and Blowers-Water Pumps-Compressors.**ALTERNATIVE ENERGY SOURCES:** Solar energy: Types of devices for solarenergycollections,Thermalstoragesystem,Controlsystems.WindEnergy, Availability,WindDevices,WindCharacteristics,performanceofturbinesandsystems. WasteMinimizationandResourceConservation.	22

TextBooks:

- H.KoontzandCyrillDonnel“Management” McGrawHill
- S.C.Kuchhal“FinancialManagement”ChaitanyaPublishingHouse.

ReferenceBooks:

- W. C., Turner and S. Doty “Energy Management Hand Book” FairmontPress, 2009, 7thedition.
- C.BSmith“EnergyManagementPrinciples”PergamonPress,2007
- W.RMurphy“EnergyManagement”Elsevier,2007.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcomes:

CO1:Understandingofenergyconservationand identificationofenergyconservation,opportunitiesinvariousindustrialprocesses.

CO2:Knowledgeofvarioustoolsandcomponentsenergyauditing.

CO3:Abilitytoevaluate theperformanceofindustrialboilers,furnacesetc.bydirectandindirectmethods.
CO4:toinvestigatecogeneration inindustryandwasteheatrecoverytechniquesanddevices.
CO5:Toconductenergyauditsindomesticandsmallindustries.
CO6:Applyknowledgetodevelopmodelandprototypeswhichcanrecoverwasteheatforenergyefficiency.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PSO1
CO2	PO1,PO3,PSO1
CO3	PO4,PO5,PSO1
CO4	PO4,PO5,PSO1
CO5	PO4,PO5,PO6,PSO1
CO6	PO4,PO5,PO6,PO7,PSO1,PSO2

BMEO0003 SMART MATERIALS

Objective:

Studentswillbeabletounderstandthevarietyofsmartmaterials,theirapplicationandadvantages.Theywillalsolearn compositematerials,theirmanufacturingprocessesandtestingmethods.

Credits:04 L–T–P:3–1–0

ModuleNo.	Content	Teaching Hours
I	**Introduction:**ClassificationsofEngineeringMaterials,Conceptofcomposite materials, Matrix materials, Functions of a Matrix, DesiredPropertiesofaMatrix,PolymerMatrix(ThermosetsandThermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, GlassMatrixetc.TypesofReinforcements/Fibers:RoleandSelectionorreinforcement materials, Types of fibres, Glass fibers, Carbon fibers,Aramidfibers,Metalfibers,Aluminafibers,BoronFibers,Siliconcarbidefibers,Quartz andSilica fibers, Multiphasefibers,Whiskers,Flakes etc., Mechanical properties of fibres. Material properties that canbeimprovedbyformingacompositematerialanditsengineeringpotential **Various types of composites:** Classification based on Matrix Material:Organic Matrix composites, Polymer matrix composites (PMC), CarbonmatrixCompositesorCarbon-CarbonComposites,Metalmatrix composites(MMC),Ceramicmatrixcomposites(CMC);	23
II	Classification based on reinforcements: Fiber Reinforced Composites,FiberReinforcedPolymer(FRP)Composites,LaminarComposites,ParticulateComposites,ComparisonwithMetals,Advantages&limitationsof Composites **Fabricationmethods:**ProcessingofCompositeMaterials:Overallconsiderations, Autoclave curing, Other Manufacturing Processes likefilamentwelding,compressionmolding,resin-transplantmethod,pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrixperforms, Manufacturing Techniques: Tooling and Specialty materials,Releaseagents,Peelplies,releasefilmsandfabrics,Bleederandbreatherplies, baggingfilms **TestingofComposites:**Mechanicaltestingofcomposites,tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminarsheartesting, Fracture testingetc.	22

Text/ReferenceBooks:

- ThomasJ.BrunoandRyanDeacon,“Vol.10:Materialscharacterization”:ASMhandbook,2019.
- G.Dieter,“MechanicalMetallurgy”:Mc-GrawHillEducation,1961.
- R.E.SpeyerandMarcelDecker,“ThermalAnalysisofMaterials”:CRCPress,1993.

- A.KBhargava,“EngineeringMaterials:Polymers,CeramicsandComposites”:PrenticeHallofIndia, 2005.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*
Outcomes:

CO1:Understandingofsmartmaterials,manufacturingprocesses,advantagesandapplications.
CO2: Identify and Evaluate the properties of fiber reinforcements, particulates, matrix materialsandcommercialcomposites.
CO3:Developcompetencyinoneormorecommoncompositemanufacturingtechniques andbeabletoselectappropriatetechniqueformanufactureofcompositeproducts.
CO4: Analyze and understand the mechanical properties and mechanics of load transfer frommatrixtofibers.
CO5: Understand and predict the mechanical performance and failure behaviour of theComposites.
CO6:Apply theknowledgeofmanufacturingmethodsandcompositemechanicalperformanceofa given composites designproject.
CO7:To understandthedifferenttestingmethods/Characterizationofsmartmaterials.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO1/PO4/PO5/PSO1/PSO2/PSO3
CO3	PO1/PSO2
CO4	PO1/PSO1
CO5	PO1/PO4/PSO3
CO6	PO1/PO2/PSO2/PSO3
CO7	PO1/PSO2/PSO3

BMEO0004 PROJECT MANAGEMENT

Objective: *The main objectives of project management are as follows: Understand exactly what a project ismeant to do and what it is meant to deliver. To learn the scope, timescales, cost and quality of a project. How tomaintain a schedule and project plan. To estimate the cost of project. Different finance institute available forfinancial add. Deliver the agreed outcomes of the project to the right scope, timescales, cost and quality. Providecommunications, reports and progress updates throughout the lifecycle of the project. To let students know howtomanagerisks, issuesand dependencies*

Credits:03 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Project Characteristics, Attributes of A Good Project Manager,TaxonomyofProjects. **ProjectIdentification&Formation:**ProjectIdentification,DemandForecasting, Project Preparation, Zero Based Project Formulation, PreliminaryProjectReport,Comparison ofProjectAlternatives. **Project Appraisal:** Technical Appraisal, Commercial Appraisal, EconomicalAppraisal, Management Appraisal, Social Cost Benefit Analysis, NPV, IRR, BCR,NBCR. **FinancingofProjects:**EstimationofCostComponentsofProjects.Sources of Finances, Role of Financial Institutions, Cash Inflow and Cash Outflow, Cost ofCapital.	20
II	**ProjectPlanning&Scheduling:**SchedulingTechniques,PERT&CPM,NetworkPreparation,UpdatingNetwork,LineofBalanceTechnique,PerformanceAnalysisofProjects,CostVsTimeofCompletion,NormalTimeand Crash Time, Resource Allocation Techniques, Work Breakdown Structure.**ProjectContracts:**TypesofContract,Sub-Contract,Tenders&TypesofPaymenttoContractors. **ComputerAidedProjectManagement:**EssentialRequirementsofSoftware's, Software Packages, Enterprise-Wide Project Management, SpreadSheets. ProjectOrganization,PostProjectEvaluation,ProjectSickness–Causes,Predictionof Causes,Rehabilitation,ProjectAudit,Risk Analysis.	20

TextBooks:

- NagarajanK.,*ProjectManagement*,NewAgeInternationalPublishers.
- PanneerselvamR.&SenthilkumarP.,*ProjectManagement*,PHILearning.

ReferenceBooks:

- PatelBhaveshM,*ProjectManagement*,VikasPublishingHome.
- ScelharamanS.&RamnathVijay,*ProjectManagement*,Breweries;Education.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*
Outcome:

Aftercompletionofthe course,studentwillbeableto:

CO1:UnderstandtheprojectcharacteristicsandTaxonomyofProject.
CO2:ApplytheknowledgeofDemandForecastinginmanagingthevariousprojects

CO3:UnderstandtheTechnical,Commercial,EconomicalandManagementAppraisal
CO4:Understandtheconceptofprojectnetwork,projectscheduleandprojectmonitoringactivities byusing CPMandPERTmethod.
CO5:proficientlyhandlethevarioussoftwarepackagesformanagingtheproject.
CO6: Determine the cost components of Projects and identify different Sources ofFinances

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program SpecificOutcomes(PSOs)

Cos	**POs/PSOs**
CO1	**PO1/PSO2**
CO2	**PO1,PO2,PO5,PO11/PSO2**
CO3	**PO1,PO11/PSO2**
CO4	**PO8,PO11,PO12/PSO3**
CO5	**PO5,PO11/PSO2**
CO6	**PO1,PO4/PSO2**

BMEO0005 RELIABILITY AND MAINTENANCE ENGINEERING

Objective: *The objective of the course is to provide the students with the fundamental concepts, maintenanceworkload analysis and calculations, maintenance work scheduling the necessary knowledge and the basic skillsrelatedtosystemreliabilityand systemsmaintenancefunctions*

Credits:03 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	Maintenance Management,Production Maintenance System, Objectives andFunctions, Forms, Policy, Planning, Organization, Economics of Maintenance,EvaluationofMaintenance Management. **MaintenanceStrategies:**BreakDownMaintenance,PreventiveMaintenance,PlannedMaintenance,MaintenanceProgramme,JobReport,Strategies. Design Out Maintenance, Planned Lubrication, Total Productive Maintenance,ZeroBreakDownManpowerPlanning,MaterialsPlanning,SpareParts PlanningandControl.	19
II	**ReliabilityEngineering:**Introduction,OperatingLifeCycle,Reliability,Failure Data Analysis, Failure Rate Curve, Hazard Models, Elements in Series,Parallel,Mix,LogicDiagrams,ImprovingReliability,Redundancy-Element,Unit,Standby,Maintainability,Availability,ReliabilityandMaintainabilityTradeOff. BreakDownMaintenancePlanning,ReplacementPlanningMaintainorReplaceDecision,ReplacementModels/Decisions,Individual,GroupReplacement, ReplacementinAnticipationofFailure. **ConditionMonitoring:**ObjectivesandTechniquesofConditionMonitoring.	21

TextBook:

- R. C. Mishra and K. Pathak, "*Maintenance Engineering & Management*": Prentice Hall of India, NewDelhi,2015.
- A. K. Gupta, "*Reliability Maintenance & Safety Engineering*": University Science, Press New Delhi,2009.

ReferenceBooks:

1. Dr.A.K.Gupta,"ReliabilityMaintenance&SafetyEngineering":UniversitySciencePressNewDelhi,2009.
2. KellyandM.J.Harris,"ManagementofIndustrialMaintenance":Boston:Newnes-Butterworths,1979.
3. B.S.Dhillon,"EngineeringMaintainability:HowtoDesignforReliabilityandEasyMaintenance":PrenticeHall ofIndia,New Delhi,1999.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Aftercompletionofcourse,the student willbe ableto:

CO1:Understandmaintenanceobjectivesandevaluatemaintenancestrategiesforprocessplantapplications.
CO2: Evaluate maintenanceschedules and assess the corresponding risks with appropriate tools&techniques.
CO3: Understand the concept of maintainability & availability and different techniques availableto improvemaintainability &availability.

CO4:Todevelopthetotaloptimumcostmodelforamaintenanceproblem.

CO5: Understand the concept of reliability & its techniques for estimating reliability andcharacteristicsofcomponents/systems.

CO6:Understandandapplytheconceptof reliabilitycentered maintenance(RCM) andadvantages for a company employing them.

CO7: Understand and apply the concept of condition monitoring techniques & its data for predictive maintenance.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO1/PO5/PSO2
CO3	PO1/PSO2
CO4	PO3/PSO1
CO5	PO4/PSO2
CO6	PO6/PSO2/PSO3
CO7	PO4/PSO2

BMEO 0006 MECHATRONICS

Objective:*Mechatronicsisthecombinationofmechanicalandelectronicsautomationandcomputers.Nowadays all the mechanical machines have been made computer controlled. The Subject details the basichardware and software elements used for proper and successful operation of various equipment. The knowledgeofthissubjectwillbehelpfultostudentswhileworking inindustries.*

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Automated Manufacturing System, need of Automation, elementsofAutomation,levelsofAutomation,Automationstrategies,advantages&disadvantagesofAutomation,CAD/CAM,CIM,FMSand CNCsystem. **MechatronicsSystem:**ElementsofMechatronicssystem,levelsofMechatronicssystem,MechatronicsDesignProcess,SystemandControl,feedback Principle, real time Mechatronics system and application, advantagesanddisadvantagesof Mechatronicssystem. **MechanicalActuatingSystems:**Typesofmotion,Degreesoffreedom,constraints, Kinematic Chains, Cam, Gear and gear trains, Ratchet and pawl Beltdrive,chain drive,bearing,preloading. Hydraulic&PneumaticActuationSystems:Fluidpowersystems,hydraulicsystems, Pneumatic systems, system structure and signal flow, hydraulic pumpsandPressureControlValves,aircompressorsandtreatment,Cylinders, DirectionControlValves,RotaryActuators.	20
II	**Electrical Actuation Systems:** Switching Devices, Mechanical Switches – SPST,SPDT, DPDT, Relays, solenoid operating Valve, Solenoid Operated Hydraulic andPneumatic Valves, Open and Close loop control system, Control of DC Motors,PermanentMagnetDCMotors,brakingofDCMotors,ACMotors,StepperMotorsandControls. **Sensors, transducers and application:** Performance Terminology, Static andDynamicCharacteristics,Displacement,PositionandProximitySensors,PotentiometerSensors,LVDT,Optical Encoders, HallEffectSensors. **Programmablelogiccontrollers:** Programmablelogiccontrollers(PLC)Structure,Input/OutputProcessing,principlesofoperation,PLC versus computer, selectingaPLC. **Casestudies:**Mechatronicapproachtodesign,BoatAutopilot,highspeedtiltingtrain,automaticcarparksystem,coincounter,enginemanagementsystem,autonomous mobilesystem,antilockbrakesystemcontrol,UsingPLC for extending and retracting a pneumatic piston and two pneumatic pistons indifferent combinations.	24

TextBooks:

- W.Bolton,"Mechatronics–ElectroniccontrolsystemsinMechanical&ElectricalEngineering",PearsonEducationLtd., 2003.
- K.P.Ramachandran,G.K.Vijayaraghavan,M.S.Balasundaram,Mechatronics-IntegratedMechanicalElectronicSystems,Wiley;

ReferenceBooks:

- JojiP,PneumaticControls,Wiley.
- DanNecsulescu,Mechatronics,Pearson
- DavidgAlciatore,Michael B Histand,“IntroductiontoMechatronics and measurementsystems”,McGraw Hill Education.
- ASmaili,FMrad,“Mechatronics–IntegratedTechnologiesfor Intelligent Machines,OxfordHigherEducation.
- NitaigourPremchandMahalik, “Mechatronics Principles, Concepts & Application”,TataMcGrawHillPublishing Co.Ltd., 2003.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3
CO7	PO1/PO2/PO12/PSO3

OPEN ELECTIVE

BMEO 0007: SIX SIGMA & APPLICATIONS

Objectives: *Study of this subject will enable the students to develop their mental horizon byenhancing their knowledge and skills which will embed organizational skill & it would be overallbeneficial for any organization. The main objective is to provide to the students its principles andproblems associates during implementation so that the students make a significant contribution to anorganizationby use itsapplications invarious areas.*

Credits: 04 **L-T-P:3-1-0**

Module No.	Contents	Teaching Hours
I	**Introduction:**Principlesofsix-sigma,Statisticalbasis,ToolsandTechniques,DMAICprinciple,6Sofsixsigma ,Customerrequirements,Eliminationof wastes anddefects, Evolution of six sigma quality approach, Practical approach to six sigmaquality, Basic steps involved in the application of six sigma, TQM and sixsigma,Qualityimprovement,Sixsigma andother qualityinitiatives. **Project Management Applications**: Areas of six sigma and its approach, Six-sigmamanagement method, Integration of project management, Effectivemanagementofsix-sigmaprojectsanddisciplinedsix-sigmamethodinmanagingprojectsin organization. **Process Control Charts**: X & R charts, p & C charts, Limits calculations;Importance&Applications.	25
II	**LeanManufacturing**:Concept,goals,components,toolsandtechniques,JIT, KANBANsystem, wastereduction. **Organizational Structure of Six-sigma**: Gains made by the global six sigmastars,sixsigmaandIndianindustries,sixsigmaconceptofprocesscapability,OrganizationalStructure,Projectmethodology,QuadrupleConstraints ofprojectmanagement,Businesssystemsimprovement,Importanceofevaluating thesuccessofprojects,Importancecareerpathrequirements. **Factories of future**: Nature and categories of FOF, Zero bases FOF, Designandplanningforfuturisticfactories.	25

Text Books:

- TheSixSigmaHandbook: AComplete GuideforGreenBelts,BlackBelts, andManagersat AllLevelsThomas PyzdekPaulA. Keller,Mc GrawHill.
- Lean Six Sigma For Dummies, 2nd Edition Published by John Wiley & Sons, Ltd.,TheAtriumSouthern GateChichesterWestSussex PO19 8SQEngland.
- THE LEAN SIX SIGMA BLACK BELT HANDBOOK Tools and Methods for ProcessAccelerationFrankVoehl •H.James HarringtonChuckMignosa•Rich Charron,CRCPress

Reference Books:

- Skimmar,Wickham, Manufacturing in the corporate Strategy, John Wiley and

sons,NewYork
- HearmBuckandButler, D.M.,Economic product Design, Colhins,London
- Cluttarbuck,JIT–AGlobal StatusReport,IFSpublications
- MichaelJ.Termini,Thenewmanufacturingengineer,Societyofmanufacture engineerMichigan,USA

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Attheendofthecoursethestudentwouldbeableto:

CO1: Explain complete range of topics starting from its basic idea to its applications in various areas.CO2: Describetools&techniques,eliminationofwastesandtheirreductioninpresent scenario.
CO3:Understandthathowtoanalysisthevariouscontrolchartsforprocessvariations.CO4: ExplaintheconceptofLean manufacturingandits widescope.
CO5:UnderstandtheBusinesssystemsimprovement,Importanceofevaluatingthesuccessofprojects.
CO6: Understand theconceptofFactoryoffuture,Zero basesFOF.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs / PSOs
CO1	PO1,PO2, PO3
CO2	PO2,PO3 / PSO1
CO3	PO2,PO3 / PSO1
CO4	PO1,PO2 / PSO2
CO5	PO1 / PSO1
CO6	PO1,PO3 / PSO1, PSO3

COURSESTRUCTURE

B.TECH. MECHANICAL ENGINEERING

(Specialization in Mechatronics Engineering)

Under

ChoiceBasedCreditSystem(CBCS)

DEPARTMENTOFMECHANICALENGINEERING,**InstituteofEngineering&Technology**

Credit Structure

S.No.	Department	Program Offered	Credits		Total Credits
1	ME	B.Tech. ME (Specialization in Mechatronics Engineering)	HSS	25	184-194
			BS	24	
			ES	28	
			PC	48	
			PE	26-36	
			OE	16	
			Project	17	
			MNG	8 U	

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics –	3	1	0	4	4
2.	BELH0001	English Language Skills forCommunication I	1	2	0	2	3
3.	BPHS0001	Engineering Physics	3	1	0	4	4
4.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
5.	BEEG1001	Basic Electrical Engineering	3	1	0	4	4
PRACTICALS							
6.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
7.	BMEG0801	Engineering Drawing	0	0	2	1	2
8.	BEEG0801	Electrical Simulation Lab	0	0	4	2	4
9.	BELH0801	English Language Lab I	0	0	2	1	2
10.	BMEG0801 /BMEG080	Engineering Drawing/Workshop	0	0	2	1	2
11.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
		Total	15	6	14	25	33

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS 0102	Engineering Mathematics – II	2	0	0	4	2
2.	BELH 0002	English Language Skills for Communication – II	1	2	0	2	3
3.	BCHS 0101	Engineering Chemistry	3	1	0	4	3
4.	BCSC 0001	Computer Programming	3	2	0	5	4
5.	B 0001	Electronics Engineering	3	1	0	4	4
6.	BMEG00 02	Applied Mechanics	3	0	0	3	3
PRACTICALS							
7.	BME G0802	Applied Mechanics Lab	0	0	2	1	2

8.	BECG 0800	Electronics Lab – I	0	0	2	1	2
9.	BCSC 0800	Computer programming lab	0	0	2	1	4
10.	BELH 0802	English Language Lab – II	0	0	2	1	2
11.	BCHS 0801	Engineering Chemistry Lab	0	0	2	1	2
		TOTAL	15	1	10	27	34

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
THEORY									
1.	BMEC0001	MaterialScience	2	0	0	0	2	2	
2.	BMEC0002	AppliedThermodynamics	3	1	0	0	4	4	BasicMechanical
3.	BMEC0003	Measurement&Metrology	2	0	0	0	2	2	-
4.	BMEC0004	Heat&MassTransfer	3	0	0	0	3	3	Applied
5.	BMEC0005	FluidMechanics	3	0	0	0	3	3	Engineering
6.	BMEC0006	ManufacturingScienceI	3	0	0	0	3	3	MaterialScience
7.	BMEC0007	StrengthofMaterial	3	0	0	0	3	3	AppliedMechanics
8.	BMEC0008	KinematicsofMachines	3	0	0	0	3	3	AppliedMechanics
9.	BMEC0009	DynamicsofMachine	3	0	0	0	3	3	KinematicsofMachines
10.	BMEC0010	MachineDesignI	3	0	0	0	3	3	StrengthofMaterial
11.	BMEC0011	MachineDesignII	3	0	0	0	3	3	MachineDesignI
12.	BMEC0012	FluidMachinery	3	0	0	0	3	3	FluidMechanics
13.	BMEC0013	ManufacturingScienceII	3	0	0	0	3	3	ManufacturingScienceI

PRACTICALS									
14.	BMEC0800	MaterialScience&TestingLab	0	0	2	0	1	2	
15.	BMEC0801	Measurement&Metrology Lab	0	0	2	0	1	2	
16.	BMEC0802	Heat&MassTransferLab	0	0	2	0	1	2	
17.	BMEC0803	FluidMechanicsLab	0	0	2	0	1	2	
18.	BMEC0804	ManufacturingScienceILab	0	0	2	0	1	2	
19.	BMEC0805	TheoryofMachineLab	0	0	2	0	1	2	
20.	BMEC0806	MachineDesignILab	0	0	2	0	1	2	
21.	BMEC0807	MachineDesignII Lab	0	0	2	0	1	2	
22.	BMEC0808	FluidMachineryLab	0	0	2	0	1	2	
23.	BMEC0809	ManufacturingScienceIILab	0	0	2	0	1	2	
Total							**48**		

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet:Design Engineering									
THEORY									
1.	BME E0201	Computer Aided Design	3	0	0	0	3	3	Machine Design II
2.	BME E0202	Continuum Mechanics	3	1	0	0	4	4	Strength of Material
3.	BME E0203	Finite Element Methods	3	1	0	0	4	4	Continuum Mechanics
4.	BME E0204	Vibration and Noise	3	1	0	0	4	4	Dynamics of Machine
5.	BME E0205	Machine Tool Design	3	0	0	0	3	3	Machine Design II & Manufacturing Sc.
6.	BME E0301	Computer Aided Manufacturing	3	0	0	0	3	3	Manufacturing Science II
7.	BME E0402	Product Development & Design	3	0	0	0	3	3	Machine Design II
8.	BME E0403	Operations Research	3	0	0	0	3	3	Industrial Engineering
9.	BME E0406	Applied Ergonomics	3	0	0	0	3	3	Product Develop ment & Design
10.	BME E0503	Engineering System Modeling & Simulation	3	0	0	0	3	3	Industrial Engineering
11.	BMEE 0306	Additive Manufacturing	3	1	0	0	4	4	
12.	BME E0307	Computer Integrated Manufacturing	3	0	0	0	3	3	
13.	BME E0308	Design for Manufacturing & Assembly	3	0	0	0	3	3	
14.	BME E0206	Mechanical Vibration	3	0	0	0	3	3	
PRACTICALS									
15.	BMEE 0184	Machine Drawing Lab	0	0	2	0	1	2	
16.	BME E0176	Advanced Software Lab	0	0	2	0	1	2	
17.	BME E0178	CAD/CAM Lab	0	0	2	0	1	2	

18.	BME E0192	Project based CAD/CAM Lab	0	0	0	8	2	8	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet: Home,IndustrialAutomation and Mechatronics									
THEORY									
19.	BMEE0304	Modern ManufacturingProcess	3	0	0	0	3	3	ManufacturingScienceII
20.	BMEE0305	MetalForming Analysis	3	0	0	0	3	3	ManufacturingScienceI
21.	BMEE0401	IndustrialEngineering	3	0	0	0	3	3	
22.	BMEE0403	OperationsResearch	3	0	0	0	3	3	IndustrialEngineering
23.	BMEE0404	ValueEngineering	3	0	0	0	3	3	IndustrialEngineering
24.	BMEE0405	SupplyChainManagement	3	0	0	0	3	3	IndustrialEngineering
25.	BMEE0501	Robotics&FMS	3	0	0	0	3	3	IndustrialEngineering
26.	BMEE0502	IndustrialAutomation&ControlSystem	3	0	0	0	3	3	IndustrialEngineering
27.	BMEE0503	EngineeringSystemModeling &Simulation	3	0	0	0	3	3	IndustrialEngineering
28.	BMEO0001	TotalQualityManagement	3	1	0	0	4	4	-
29.	BMEO0004	ProjectManagement	3	1	0	0	4	4	-
30.	BMEO0005	ReliabilityandMaintenanceEngineering	3	1	0	0	4	4	-
31.	BME E0307	Computer Integrated Manufacturing	3	0	0	0	3	3	
32.	BME E0505	Fundamentals of Mechatronics and Applications	3	1	0	0	4	4	
33.	BME E0309	Manufacturing Systems Simulation	3	1	0	0	4	4	
34.	BME E0506	Sensors and Actuators	3	1	0	0	4	4	
PRACTICALS									
35.	BMEE0179	Modern ManufacturingProcessLab	0	0	2	0	1	2	
36.	BMEE0193	Project based ModernManufacturingProcessLab	0	0	0	8	2	8	

37.	BMEE0182	Robotics&FMSLab	0	0	2	0	1	2	
38.	BMEE0196	ProjectbasedRobotics&FMSLab	0	0	0	8	2	4	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
Bouquet:Fluid and Thermal Engineering									
THEORY									
39.	BMEE0001	Refrigeration & Air-Conditioning	3	0	0	0	3	3	AppliedThermodynamics
40.	BMEE0002	InternalCombustionEngine	3	0	0	0	3	3	AppliedThermodynamics
41.	BMEE0004	PowerPlantEngineering	3	0	0	0	3	3	AppliedThermodynamics
42.	BMEE0005	GasDynamics	3	1	0	0	4	4	AppliedThermodynamics
43.	BMEE0006	GasTurbineandJetPropulsion	3	1	0	0	4	4	AppliedThermodynamics
44.	BMEE0007	AdvancedHeatTransfer	3	0	0	0	3	3	HeatTransfer
45.	BMEE0008	SolarEnergy	3	0	0	0	3	3	AppliedThermodynamics
46.	BMEE0009	IntroductiontoVehicleDynamics	3	0	0	0	3	4	Automobileengineering
47.	BMEE0101	AdvancedFluidMechanics	3	1	0	0	4	4	FluidMechanics
48.	BMEE0102	CompressibleFluidFlow	3	1	0	0	4	4	Advanced FluidMechanics
49.	BMEE0103	Aerodynamics	3	0	0	0	3	3	Advanced FluidMechanics
50.	BMEE0104	TurbulentFlow	3	1	0		4	4	Advanced FluidMechanics
51.	BMEE0105	ComputationalFluidDynamics	3	0	0	0	3	3	Numerical Methods&TurbulentFlow
52.	BMEO0002	EnergyConservation&Management	3	1	0	0	4	4	-
PRACTICALS									
53.	BMEE0170	Refrigeration & Air-ConditioningLab	0	0	2	0	1	2	
54.	BMEE0172	SolarEnergyLab	0	0	2	0	1	2	
55.	BMEE0186	ProjectbasedSolarEnergyLab	0	0	0	8	2	8	
56.	BMEE0175	CFDLab	0	0	2	0	1	2	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
1.	BEEJ0950	Mini Projects - I	0	0	0	4	1	4	
2.	BEEJ0951	Mini Project - II	0	0	0	12	3	12	
3.	BEEJ0953	Minor Project	0	0	0	12	3	12	
4.	BEEJ0955	Major Project	0	0	0	32	8	0	
5.	BEEJ0991	Industrial Training	0	0	4	0	2	0	
		TOTAL	**0**	**0**	**0**	**60**	**17**		

Mandatory Non-Graded Course (M)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
		THEORY							
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
		TOTAL	**8**	**0**	**0**	**0**	**0**	**8**	

Humanities and Social Sciences (H)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purpose – I	2	0	0	0	2	2	
4.	BELH 0004	English for Professional Purpose – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAC0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH 0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	4	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	4	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences (S)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences (G)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BEEG0002	Electrical Technology	3	0	0	0	3	3	
5.	BCSC0001	Computer Programming	4	1	0	0	5	5	
PRACTICALS									
6.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
	BEEG0801	Electrical Simulation Lab	0	0	4	0	2	4	
7.	BEEG0802	Electrical technology Lab	0	0	2	0	1	2	
8.	BME G0803	Computer aided drafting lab	0	0	2	0	1	2	
9.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
10.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
11.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
TOTAL			16	4	14	0	28	16	

Open Elective (Offer to other Departments)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMEO0001	TotalQualityManagement	3	1	0	0	4	4	
2.	BMEO0002	EnergyConservation&Management	3	1	0	0	4	4	
3.	BMEO0003	SmartMaterials	3	1	0	0	4	4	
4.	BMEO0004	ProjectManagement	3	1	0	0	4	4	
5.	BMEO0005	ReliabilityandMaintenanceEngineering	3	1	0	0	4	4	
6.	BMEO0006	Mechatronics	3	1	0	0	4	4	
7.	BMEO0007	SixSigma&Applications	3	1	0	0	4	4	

BMEG 0001:BASIC MECHANICAL ENGINEERING

Objective: *Precisethermodynamicseducationisarequirementtodiscussissuesthatonefacesinthermodynamics and resulting studiesin global warming, energy conversion and other energy related topicsthat affect sustainability of the environment in the global sense. Also introduce the students to various basicmanufacturingprocessescarriedoutinvariousindustriesverycommonly.*

Credits:04 **SemesterI/II** **L–T–P:3–1–0**

Module No.	Content	TeachingHours
I	**Fundamentals of Thermal Engineering:** Thermodynamic systems, State &properties, Thermodynamic equilibrium & processes, Heat & work, Workdone for different polytrophic processes, Zeroth law of thermodynamics andits applications, First law of thermodynamics, Steady flow energy equation,Applicationoffirstlawtovariousthermodynamicsystemsanditslimitations. **Second Law of Thermodynamics:** Concept of heat engine, heat pump &refrigerator,SecondLawofThermodynamics,CarnotCycle,Carnottheorem.	20
II	**ConceptofEntropy:**ClausiusInequality,Conceptofentropy,Entropychangeduringvarious processes. **Steam & its Properties:** Definition of pure substance, Phase change, p-Tdiagram and pV-T surfaces, Formation of Steam, Concept and determinationof dryness fraction of steam, Thermodynamic properties of steam, SteamtableandMollier diagram. **Introduction to Manufacturing Processes**: Mechanical properties ofmaterials, Engineering Materials: Plain carbon steel and its applications**Casting Process:**Patterns and typesof patterns andtheir allowances,Moulding sandanditsproperties,Elements of gating system**.** **Fabricationprocesses:**Introductionandclassificationofwelding,principleand applications ofShieldedMetalArcWelding andGas Welding.	20

TextBooks:

- YadavR.:“*ThermodynamicsandHeatEngines*”:VolI&II (SlEdition)CentralPublishingHouseAllahabad, 2010.
- KumarD.S:“ThermalScienceandEngineering”:S.KKatariaandSons,Delhi,2004.

ReferenceBooks:

- NagP.K.:“*EngineeringThermodynamics*”:TMH,2017.
- Yadav R.: “*Thermodynamics and Heat Engines*” : Vol I & II (Sl Edition) Central Publishing HouseAllahabad, 2010.
- HajraChowdharySKandHajraChowdharyAK.“*WorkshopTechnology*”:MediaPromotors&Publishers,2010.
- RaghuwanshiRS,“*WorkshopTechnology*”:DhanpatRaiandSons,NewDelhi,2012.
- WarkWenneth:“*Thermodynamics*”:McGrawHillbookCo.NY,2015.

Outcome: *Attheendofthecoursethestudentwillbeableto:*

- *CO1:Understandthebasiclawsofthermodynamicsandtheirapplicationsinrealworld.*
- *CO2: Calculateheatand energy transfer occur in atmosphereand incomponents under thermalengineeringapplications.*
- *CO3:Interpretthebehaviorofsteamanditsapplicationsinthermalengineering.*
- *CO4:Acknowledgetheapplicationofthermalengineeringassociatedwithhumanbody.*
- *CO5:Understandthebasic industrial processes of metal joining,fabrication &castingwithapplicationsinrealworld.*
- *CO6:Developbasicknow howandawarenessofvariousmanufacturingprocesses.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO7,PO6/PSO1
CO2	PO1,PO6,PO7/PSO1
CO3	PO1,PO7/PSO1
CO4	PO1/PSO1
CO5	PO1,PO5/PSO2
CO6	PO1,PO5/PSO2

BMEG0002APPLIEDMECHANICS

Objective: *Theaimoftheappliedmechanicsistoteachthe basicanalyticalmethodsthatisthefundamentalconceptsandtechniquesofengineeringmechanics.*

- *To givestudentspracticeinapplyingtheirknowledgeofmathematics,science,and engineeringandtoexpandthisknowledgeinto thevastarea ofAppliedMechanics.*
- *Toenhancestudents'abilitytodesignbyrequiringthesolutionofopenendedproblems.*
- *Topreparethestudentsforhigherlevel coursessuchascourses in MechanicsofSolids,MechanicalDesignandStructuralAnalysis.*

Credits:04 **SemesterI/II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:-** Mechanics:IdealizationofBodies,conceptofRigidBodies,ExternalForces,Moment andCouple,LawsofMechanics. **ForceSystemsAndEquilibrium:-** FundamentalConceptsandprinciplesofMechanics.Reductionofasystemofforcestoaforcecouplesystem,Concurrentforcesinaplane,FreeBodyDiagrams,Equations of equilibrium and their applications to various systems offorces. **Friction: - Friction forces and laws of dry friction,** Types of frictionandtheir applicationstoladderandbelt-pulleysystems **DistributedForcesandMomentOfInertia:-**BasicconceptsofCentroid, Area Moment of Inertia, Polar Moment of Inertia, Product ofinertia,Principalaxes,Parallelaxistheorem,Perpendicularaxistheoremandtheirapplicationsin Compositefigures.	22
II	**Beams:-**IntroductionofaBeamandits types**,**Conceptofbendingmoment and shear forces in beams, Shear Force and Bending MomentDiagramsfordifferentloadingconditions(pointload,uniformlydistributedload,uniformlyvaryingloadandcouple). **AnalysisofPlaneTrusses:-** Engineeringstructures,PerfectTruss,Determination of axial forces in the members, Method of Joints, MethodofSections. **KinematicsandKineticsofRigidBodies:-**Plainmotionofrigidbodies, Velocity and acceleration under translation and rotation, Work,PowerandEnergy, Impulseand Momentum,D'Alembert'sPrincipleand Lawof conservationofenergy.	23

TextBooks:

- Tayal,A.K.EngineeringMechanics:Statics&Dynamics,14thEdition(2011),UmeshPublications,Delhi
- V.S.Mokashi,EngineeringMechanics:StaticsVol.I&DynamicsVol-II,(TataMcGraw-Hill),NewDelhi

ReferenceBooks:

- Shames,I.H(1996),EngineeringMechanics,StaticsandDynamics4thedition,PrenticeHallofIndiaPvt.Ltd.,NewDelhi(EEE)
- F.P.Beer&E.R.Johnstonet.al.,VectorMechanicsforEngineers:StaticsandDynamics,12thEdition(2019)TMHNewDelhi

Outcome:*Attheend ofthecoursethestudentwillbeableto:*

- *Understandtherepresentationandanalysisofforces,moments,andequilibriumofparticlesandrigidbodies,Conceptand principlesofworkand energy.*
- *Theeffectoffrictionanditsroleinengineeringapplications.*
- *Developbasicknowhowand awarenessto dealwith reallifeapplicationsinvarious fieldsofengineering.*
- *Determine internal actions in statically determinate structures and draw internal action diagrams –Shear Force(SFD)and Bending MomentDiagrams(BMD)forthesestructures.*
- *Identifyanappropriatestructuralsystemtostudyagivenproblemandisolateitfromitsenvironment*
- *Developconceptsofrigidbody kinematicsanddynamicswith anemphasisonthemodeling,analysis,andsimulation ofhowforcesproducemotionofrigid bodysystems.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2/PSO1
CO4	PO1,PO2/PSO1
CO5	PO1,PO2/PSO1
CO6	PO1,PO2/PSO1
CO7	PO1,PO2/PSO1
CO8	PO1,PO2/PSO1

BMEG0800:ENGINEERINGWORKSHOPPRACTICELAB

Objective: *The purpose of this lab is to enable the students to have the practical skills for basic manufacturingprocesses and to study the various tools & equipment used e.g. Machining, Surface finishing, Welding, Casting,Drawings (Developments), Measuring instruments. The student will also have practical exposure with varioussafetyprecautionsindifferentsectionsoftheshops.*

Credits:01 **L–T–P-J:0–0–2-**

ModuleNo.	**Content**	**Lab Hours**
I	**<u>ListofExperiments</u>** **<u>MachineShop:</u>** **(1)** Tostudytheworkingofbasicmachinetoolslike Lathem/c,andDrillingm/c. **(2)** ToperformthefollowingoperationsonCentreLathe: **(i)** Centering,Facing,Turning,Stepturning,Taperturning. **(ii)** Knurling,Grooving,Chamfering,and Threading. **<u>WeldingShop:</u>** **(1)** TopreparaLapjoint,Buttjoint,T-jointbyusinganElectricArcwelding. **(2)** TopreparaLapjoint,Buttjoint,T-jointbyusinganOxy-Acetylenegaswelding. **<u>CarpentryShop:</u>** **(1)** To performdifferentoperationsin Carpentryshop such ascutting,planningandchiselingonthegivenwoodenpiece. **(2)** TopreparajointLapjoint,T-Joint,Dovetailjointbyusingwoodenspecimen/piece. **<u>FoundryShop:</u>** **(1)** To prepareaSandmouldforsolidcastingwiththehelpsinglepiecepattern&splitpattern. **(2)** Topreparethemouldforhollowcasting withthehelpofpatternand core. **<u>SheetMetalShop:</u>** **(1)** Todeveloptheblankdimensions forthegivenproductusingdevelopmentprocess. **(2)** TopreparaFunnelofrequireddimensionsusingjoiningprocesses. **<u>FittingShop</u>:** **(1)** To performtheoperationsofMarking,FilingandSawingonthe givenmetallicwork-piece(M.S.)as pergivendimensions. **(2)** Toperformtheoperationsofdrillingofmakingtheholesonthegivenmetallicwork-piece(M.S.)byuseofDrillingmachine. **(3)** Toperformtheoperationsofmakinginternalthreadsbyuseoftapesanddies.	30

Text/ReferenceBooks:

- *JohnK.C.,“MechanicalWorkshopPractice”:PHILearningPvt.Ltd.,NewDelhi,2010.*
- *ChoudharyHajra,“ElementsofWorkshopTechnology”:MediaPromoters&PublishersPvt.Ltd.,Mumbai,2010*

- *Chapman W.A.J., "Workshop Technology", CBS Publishers & Distributors, New Delhi, 2007*

Outcome: *On successful completion of this lab, the students will be able to:*

- *CO1: Demonstrate an understanding of and comply with workshop safety regulations.*
- *CO2: Select and perform a range of machining operations like: turning, facing, knurling drilling, grinding etc. to produce a given job.*
- *CO3: Acquire basic knowledge of welding, joint design such as Lap joint, Lap T-joint, Edge joint, Butt joint and Corner joint and the application of welding.*
- *CO4: Ability to design and model different prototypes in the carpentry trade such as Cross lap joint, Dovetail joint.*
- *CO5: Ability to design and model various basic prototypes in the trade of fitting such as Straight fit, V-fit.*
- *CO6: Ability to make various basic prototypes in the trade of Tinsmithy such as rectangular tray, and open Cylinder.*
- *CO7: Student will able to design mould with the help of green sand mould.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1
CO2	PO1,PO3/PSO1
CO3	PO1,PO3/PSO1
CO4	PO3/PSO1
CO5	PO3/PSO1
CO6	PO3/PSO1
CO7	PO3/PSO1

BMEG0801ENGINEERINGDRAWING

Objective: *Technical drawing is the language of engineering. The objective of this course is to learn initially thebasic principles involved in the projection of points, lines, lamina and solids. As well this course isfocusedtowards the interpenetration of solids, development of surfaces, isometric drawings and some basics of computeraided drafting software. It is expected that a student should learn this subject in a verysystematicway todeveloptheskilltoexpresseffectivelyhis/herideaaboutanobjecttoothersthroughdrawings.*

Credits:01 **SemesterI/II** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**Introduction** Drawinginstrumentsandtheiruses,BISconventions,letteringdimensioningand freehandpracticing (2 Drawing sheets)**Geometricconstruction&engineering Scales** Basicgeometricconstruction-Dividingagivenstraightlineintoanynumber of equal parts, drawing a regular polygon given one side, conicsections – ellipse – parabola. Concepts of scales –Plain, Diagonal & scaleofchord.(2Drawingsheets) **Orthographicprojection** Introductiontoprojection&orthographicProjections *Projectionsofpoints*lyinginfourquadrants *Projectionoflines*-parallelandinclinedtooneorbothplanes *Projectionofplanes*-inclinedtooneorbothplanes. *Projectionsofsolids*-axisperpendiculartoHP,axisperpendiculartoVPandaxis inclinedtooneorbothplanes. (4 Drawing sheets)**Sectioning of solids-** Section planes perpendicular to one plane andparallelorinclined tootherplane. (1Drawingsheets)**Development of surfaces-** Development of prisms, pyramids andcylindrical&conicalsurfaces (1Drawingsheets)**Isometric projection -**Isometric projection and isometric views ofdifferentplanesandsimplesolids (1Drawing sheets) **Computeraideddrafting**Introductiontocomputeraideddraftingpackageto make2-Ddrawings.	24

TextBooks:

- Venugopal,K.andPrabhuRaja,V.:'EngineeringDrawingandGraphics+AutoCAD':NewAgeInternational,2017.
- Agrawal&Agrawal,C.:'EngineeringDrawing':TataMcGrawHill,2014.

ReferenceBooks:

- Bhatt,N.D.andPanchal,V.M.,'EngineeringDrawing':CharotarPublishingHouse,2010.
- Natarajan,K.V.,'AtextbookofEngineeringGraphics':DhanalakshmiPublishers,Chennai,2014.
- Venugopal,K.andPrabhuRaja,V.,'EngineeringDrawingandGraphics+AutoCAD':NewAgeInternational,2017.
- Jolhe,D.A.,'Engineeringdrawing':TataMcGrawHill,2010.

- TrymbakaMurthy,S.,‘ComputerAidedEngineeringDrawing’:I.K.InternationalPublishingHouse, 2008.
- Agrawal&Agrawal,C.,‘EngineeringDrawing’:TataMcGrawHill,2014.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Course Outcomes:*Attheendofthecoursethestudentwillbeableto*

- *CO1:Knowandunderstandtheconventionsandthemethodsofengineeringdrawing.*
- *CO2:Interpretengineeringdrawingsusingfundamentaltechnicalmathematics.*
- *CO3:Improvetheirvisualizationskillsso thattheycanapplytheseskillsindevelopingnewproducts.*
- *CO4:Improvetheirtechnicalcommunicationskillintheformofcommunicativedrawings.*
- *CO5:Comprehendthetheoryofprojection,Interpretviewsandsectionalviewsandprojections.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO3/PSO1
CO4	PO10/PSO1
CO5	PO3/PSO1

BMEG0802APPLIEDMECHANICSLAB

Objective: *This course introduces the fundamentals of statics in engineering, which are prerequisites for further study of advanced mechanics. The main objective of the course is to learn basic principles of static in mechanics analyses, such as rigid bodies, friction between two surfaces, centroid, reaction of beam, Newton's laws of motion and analysis of truss. It also includes a range of essential steps for solving problems in statics.*

Credits:01 **SemesterVI** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
1	**ListofExperiments:** **1.** Studyoffunctioningofgeartrains. **2.** Tofindthemechanicaladvantages,velocityratioandefficiencyofwormandwormwheel. **3.** Tofindthecoefficientoffrictionbetweenthesurfaceofagivenwoodslidebarandaninclinedplane. **4.** Tofindcentreofgravityofdifferentgeometricalobjects. **5.** Deflectionofsimplysupportedbeamandverificationoftheoreticalvalues. **6.** Tofindreactionatthesupportsofasimplysupportedbeamwithdifferent typesofloading. **7.** Todeterminethemodulusofrigidityofrodwiththehelpoftorsion testingmachine. **8.** Tostudyfunctioningofbeltpulleysystems. **9.** Tofindmomentofinertiaofaflywheelabouttheaxisofrotation using electroniccountermachine. **10.** Tofindforcesinmembersofatrussfordifferentload conditions.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheendofthecoursethestudentwillbeable

- ✓ *To knowthepractical skillstoanalyzetheforces,moments,andtheirequilibrium.*
- ✓ *Toknowthepracticalskillsto analyzetheeffectoffriction.*
- ✓ *Todevelop basic,knowhowandawarenesstodealwithpracticalaspectsofappliedmechanics.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2/PSO1

BMEG0803COMPUTERAIDEDDRAFTINGLAB

Objective: *Theobjectiveofthiscourseistoteachusersthebasiccommandsandtoolsnecessaryforprofessional2D drawing,design anddraftingusingAutoCAD.*

Credits:01 **SemesterI/II** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**GettingStart–** Startingwithautocad,openandsavefiles,toolbars,screenlayouts. **BasicDrawing&EditingCommands-** DrawingLines,rectangles,Circles,viewingDrawing,Undo&Redocommands,Erasingobjectsetc. **DrawingPrecision-** UsingObjectsnap,Osnapoverrides,Polartrackingsettings,DrawingwithSNAP&GRID,function keys. **ChangesinDrawings-** Selectingobjectforediting,Movingobjects,copying,Rotatingobject,Scaling,mirroringeditingwithGrips. **DrawingOrganization&InformationLayers** Templates,Layers,LayerState,changingobjectlayers,etc. **AdvanceEditingCommands-** Trimming & extending, Stretching, Creating Fillets and Chamfers,Offset,creatingarraysofobjects. **Blocks** InsertionofBlockfromtoolPalettes,usinginsert,withdesigncentre. **Annotation-** Text,Hatching,Dimensions **3DModeling-** Introduction, basic tools, 3D navigation tools, UCS.Formationofsimplesolids,solidprimitives,meshmodel. **Creatingsolid**from 2D–Extrude,Swept,revolvesolid,loftedsolid. **EditingSolid**-Editingfacesofsolid,Filletandchamfer onsolids 2dviewfrom 3d.Multipleviewports	**24**

TextBooks:-

- TrymbakaMurthy,S.,'ComputerAidedEngineeringDrawing',Pub-I.K.InternationalPublishingHouse.
- Venugopal,K.and Prabhu Raja,V.,'EngineeringDrawingand Graphics+AutoCAD',Pub-NewAgeInternational

Outcome: Aftercompletingthiscoursethestudentwillbeableto:

- *CO1*:UseAutoCADfordailyprocesses requiringdesigninganddrafting.
- *CO2*:NavigatethroughoutAutoCADusingmajornavigatingtools.
- *CO3*:Understandtheconceptandtechniquestodrawtypicalgeometries.
- *CO4*:Createmultipledesignsusingseveraltools.
- *CO5*:Createlayerstocontroltheobjects'visibility.
- *CO6*:Explaindrawingusingannotations.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

MappingofCourseOutcomes(Cos)withProgrammeOutcomes(Pos)andProgrammeSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO9/PSO1
CO2	PO3,PO4,PO5/PSO3
CO3	PO1,PO2,PO3/PSO3
CO4	PO1,PO2,PO5/PSO1
CO5	PO1,PO3,PO10/PSO3
CO6	PO1,PO5,PO10/PSO3

BMEC0011MATERIALSCIENCE

Objective: *To introduce the fundamentals of biomaterials, nanomaterials, ceramics, metals, polymers,electronic materials and composites, smart materials, green and sustainable materials emphasizingthe relationships between atomic structure and microstructure as well as the properties, processingandperformanceofthematerialinacohesiveandself-containedwaywithinthecourse.*

Credits:02 **L–T–P:2–0–0**

Module No.	Content	Teaching Hours
I	**CrystallographyandImperfections:**ConceptofUnitCellSpaceLattice,Bravais-Lattices,AtomicPackingFactorandDensitycalculations,Millerindices,ImperfectionsandDislocationsinSolids. **Introduction to Non Destructive Testing:** Liquid penetrant Testing,MagneticParticleTesting,UltrasonicTesting,EddycurrentTesting, Radiography,X-RayCrystallography. **Fatigue**: Stress cycles, Factors affecting fatigue, application of fracturemechanics to fatigue crackpropagation, **Creep:**Creepcurve,stagesincreepcurveandexplanation,creepmechanisms,metallurgicalfactors affectingcreep. **StrengtheningMechanism:**ConceptofGrainandGrainBoundary,Hall-Petchstrengthening,Solidsolutionstrengthening,precipitationstrengtheninganddispersionstrengthening.	22
II	**Equilibrium Diagrams:** Types of Equilibrium-Diagrams: Solid-SolutionType, Eutectic Type and Combination Type. Iron-Carbon Equilibrium-Diagram andItsImportance. **Heat Treatment:** Various Types of Heat Treatment Such As Annealing,Normalizing,Quenching,TemperingandCaseHardening.TimeTemperatureTransformation(TTT)Diagrams. **CorrosionScience:**Definitionandimportance,Electrochemicalreactions, Polarization, Passivity, Environmental effects, Eight forms ofcorrosion, **Prevention and control of corrosion:** Cathodic protection,Coatings andinhibitors. **PropertiesandApplication:**ConceptofMagnetismandMagneticmaterials,Ceramics,Superconductorsanditstypesandphenomenonof Superconductivity, Metallic foams, Polymers, Composites, Carbon fibre,Graphene,NanoMaterials, SmartMaterials.	22

TextBooks:

- GuptaK.M.,"*MaterialsScience*",UmeshPublication.
- RaghvanV.,"*MaterialScience*",PrenticeHall.
- Narula,"*MaterialScience*",TMH.
- Fontana,M.G.,"*CorrosionEngineering"*,TataMcGraw-Hill.

ReferenceBooks:

- CallisterW.D.,JR,"*MaterialScience&Engineering*",Addition-WesleyPublication.
- VlackVan,"*ElementsofMaterialScience&Engineering*",JohnWiley&Sons.
- Avner"IntroductiontoPhysicalMetallurgy"TMHPub

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CO1:Understandingofthecorrelationbetweentheinternalstructureofmaterials,theirm echanicalpropertiesand

CO2:Understandingofvariousmethodstoquantifytheir mechanicalintegrityandfailurecriteria

CO3:Understandingof detailed interpretationofequilibrium phasediagrams.

CO4:BasicUnderstandingofdifferentphasesandheattreatmentmethodstotailorthepro pertiesof Fe-C alloys

CO5: Knowledge of various alloying elements, their properties and applications.CO6:knowledgeof smart materials andtheiruniqueapplications

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PO3/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEC0800:MATERIALSCIENCEANDTESTING LAB

Objective: *To introduce the microstructure of solids in reference to solids viewed at the subatomic (electronic)and atomic levels, and the nature of the defects at these levels. The microstructure of solids at various levelsprofoundlyinfluencesthemechanical,electronic,chemical,andbiologicalpropertiesofsolids.Thephenomenological and mechanistic relationships between microstructure and the macroscopic properties ofsolidsare, inessence, what materialsscienceisallabout.*

Credits:01 **L–T–P:0–0–2**

ModuleNo.	Content	Teaching Hours
I	**ListofExperiments** • ToPrepareSpecimenforMicroStructuralExamination-Cutting,Grinding, Polishing,Etching. • ToStudyCrystalStructuresandCrystalsImperfectionsUsingBallModels. • ToStudyBravaisLattice withHelpofModels. • ToDeterminetheGrainSize ofAGivenSpecimen. • Make A Comparative Study of Microstructures of Different GivenSpecimens after Micro Structural Examination (Mild Steel, Gray C.I.,Brass,CopperEtc.) • HeatTreatmentExperimentsSuchAsAnnealing,Normalizing,Quenching,CaseHardeningandComparisonofHardnessbeforeandAfter. • ToDeterminetheStrengthByTestingofAGivenMildSteelSpecimenonUTM WithFullDetailsand PlotontheMachine.	12
II	• ToConductShearandBend TestsonUTM. • To Conduct Impact Testing on Impact Testing Machine Like Charpy,Izodor Both. • ToConductHardnessTestingofGivenSpecimenUsingRockwellandVickers/Brinell TestingMachines. • ToCalculatetheDeflectionofBeamandYoung'sModulusofElasticityofaMaterialofaBeamSimplySupportedat theEnds. • ToConductTorsionTestingofARodonTorsionTestingMachine. • ToDeterminetheSpringIndexTestingonSpringTestingMachine. • ToPlotACurveBetweenStrainVsTime(E-T)forCreepTestingonCreepTestingMachine. • StudytheMicrostructureofWeldedComponentandHAZ(HeatAffected Zone)MacroandMicroExamination.	12

TextBooks:

1. W.D.Callister,2006,"MaterialsScienceandEngineering-AnIntroduction",6thEditionWileyIndia.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall ofIndiaPrivateLimited, 4thIndian Reprint, 2002.

ReferenceBooks:

1. Raghavan,“MaterialScienceandEngineering’,PrenticeHallofIndiaPrivateLimited,1999
.
2. MechanicsofmaterialsbyJames M.Gere.
3. IntroductiontoengineeringmaterialsbyB.K. Agarwal.
4. Physicalmetallurgyandadvanced materials byR.E. Small man.
5. EngineeringmechanicsofcompositematerialsbyIsaacM.Daniel.
6. U.C.Jindal,“EngineeringMaterialsandMetallurgy”,Pearson,2011.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:Aftercompletionofcourse,thestudentwill beableto:

CO1:Understandthevarious crystalstructureusingball andstickmodels.

CO2:Todemonstrate,analyseandpredictthemechanicalbehaviourpresentindifferentengineering materials such as CI, MS etc.

CO3:TounderstandtheworkingofhardnesstestingmachineslikeRockwell,Brinell’shardnessm achinesand instruments likedial gauge,VarnierCallipersetc.

CO4:Understandthevariousheat-treatmentmethodsandtheireffectonmicrostructureandmechanicalproperties

CO5:Understandthepropertiesofmaterialsusingdestructivetesting.

COs	*POs/PSOs*
CO1	*PO1/PSO3*
CO2	*PO1/PSO3*
CO3	*PO1/PSO3*
CO4	*PO1/PSO3*
CO5	*PO1/PSO3*

BME C0002APPLIEDTHERMODYNAMICS

Pre-requisite:_BasicMechanicalEngineering_

Objective:_Toapplybasicsofthermodynamicsandphysicsindesignofthermodynamicsystems._

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Basics of thermodynamics:** Learning Objective, Definition, First law,Secondlaw,conceptofentropy,differentialentropyrelations. **ThermodynamicsRelation:**,LearningObjective,Introduction,Helmholtz and Gibbs Function, Maxwell Relation, Chaperon Equation,Joule Thompson Coefficient and Inversion Curve, Coefficient of VolumeExpansion,AdiabaticandIsothermalCompressibility. **AvailabilityandIrreversibility:**LearningObjective,Introduction,AvailableandUnavailableEnergy,AvailabilityandIrreversibility,SecondLawEfficiency.**SteamGenerator:**LearningObjective,Introduction,Steamproperties,FunctionofBoilers,ClassificationofBoilers, Modern Boilers, Working of Fire Tube and Water Tube Boiler,Mountings and Accessories, Draughtand ItsCalculation, PerformanceofBoilers.Heatbalancesheetofboiler. **Condensers and Cooling Towers:**Learning Objective, Introduction,FunctionofCondenser,CondensingSystem,SurfaceandJet Condensers,MassofCirculatingWater,CondenserandVacuumEfficiency,Cooling Tower:Construction Details andAnalysis.	22
II	**VapourPowerCycle:**LearningObjective,Introduction,ReviewofCarnot and Rankine Cycle, Effect of Operating Conditions on ThermalEfficiency of Rankine Cycle, Principle Methods of Increasing ThermalEfficiency,DeviationofActualCycleFromTheoreticalCycle,RegenerativeFeedHeatingCycles,ReheatingandRegenerativeCycles ,BinaryVapour Cycle. Case study of design and installation of thermalpower plant of 500 MW to fulfill requirement of small medium city .**FlowThroughNozzlesandDiffusers:**LearningObjective,Introduction,ClassificationofNozzlesandDiffusers.SteadyFlowEnergy Equation Through Nozzles, Momentum Equation. Nozzle andDiffuser Efficiencies, Mass Flow Rate Through Nozzle Under IsentropicFlowCondition,GeneralRelationship,BetweenArea,VelocityandPressureinNozzlesandDiffuser,SupersaturatedFlowThroughNozzles,EffectofVariationofBackPressureinNozzle. **SteamTurbines:**LearningObjective,Introduction,PrinciplesofWorkingofSteamTurbines,Classification&Comparison,VelocityDiagramFor ImpulseandReactionTurbines.Staging,StageandOverall Efficiency,Reheat Factor,Bleeding.	23
	Totalcontacthours(lectures)	45

TextBooks:

- Domkundawar S, Kothandaraman C.P, Domkundawar A.V "Thermal Engineering" Dhanpat Rai &Sons.
- Yadav R., "*Steam & Gas turbines and Power Plant Engineering*", VII ed., 2004, Central Publishing HouseAllahabad.
- RajputR.K.,"*ThermalEngg*."DhanpatRai&Sons.
- NagP.K.,"*BasicandAppliedThermodynamics*",TMHPublicationNewDelhi.
- KeartonW.J.,"*TheoryofSteamTurbine*", DhanpatRaiandSons

ReferenceBooks:

- YunusA.Cengel. AndMichaelA.Boles., "Thermodynamics:AnEngineering Approach",McgrawHillEducation
- Ennis W.D.,"AppliedThermodynamicsForEngineers",D.VanNostrandCompany.
- Davies D.,Jeremy.,"ConciseThermodynamics:PrinciplesandApplications",HorwoodPublishing
- McConkeyA.andEastopT.,"AppliedThermodynamicsforEngineeringTechnologists"PearsonIndia

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Aftercompletingthissubjectstudentswillbeableto:*
CO1.Determinetheavailabilityandirreversibilityofopenandclosedsystemthermodynamiccycles.(Understand)
CO2. Understand Maxwell's and thermodynamic relations of gas mixtures.(Understand)CO3.Understandtheworkingofboilersandevaluate theboilerperformance.(Understand)

CO4.EvaluatethethermalefficiencyofRankine cycle,regenerativecycleandreheatcycle.(Understand)

CO5.UnderstandtheworkingofcondensersandcoolingtowersandevaluatetheCondensersefficiencyandvacuum efficiency.(Understand)
CO6.Understandbasicconcepts,energyequationsandworkingofnozzleanddiffuser.(Understand)

CO7.Understandtherelationshipbetweenarea,pressureandvelocityofsteamnozzlesanddiffusersandevaluatethe efficiencyofnozzlesanddiffusers.(Understand)
CO8.Analyzeimpulseandreactionsteamturbomachinesforenergytransfer.(Apply)

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	PSO/PO
CO1	PSO1/PO1/PO2/PO5/PO6
CO2	PSO1/PO1/PO2
CO3	PSO1/PO1/PO2/PO6
CO4	PSO1/PO1/PO5/PO6
CO5	PSO1/PO1/PO5/PO6
CO6	PSO1/PO1/PO5/PO6/PO7
CO7	PSO1/PO1/PO3/PO5/PO6/PO7
CO8	PSO1/PO1/PO3/PO5/PO6/PO7

BMEC0003MEASUREMENTANDMETROLOGY

Objective:

Todevelopinstudentstheknowledgeofbasicsof Measurements,MetrologyandMeasuringdevices.

Credits:02 **SemesterIV** **L–T–P:2–0–0**

ModuleNo.	**Content**	**Teaching Hours**
I	**Introduction to measurement:** Generalized measuring system and itsfunctionalelement,unitsofmeasurement,staticcharacteristicsofmeasuringinstruments,SystematicandRandomerrors,Statisticalanalysis of errors,Calibration. **Measurementofgeometricforms:**Measurementofroundness,flatness andstraightness. **SensorsandTransducers:**Introductiontosensorsandtransducers.**Limits, fits and Tolerances:** Interchangeability, selective assembly,limits,fit andtolerances,limitgauging,design oflimitgauges.	15
II	**StrainMeasurement:**TypesofStrainGaugesandTheirWorking,StrainGaugeCircuits,TemperatureCompensation. **MeasurementsofForceandTorque:** IntroductiontoDevicesused forMeasuring ForceandTorque. **LinearMeaurementandAngularMeasurement:** Steelrule, verniercaliper,vernierheightgauge,verniermicrometers,Anglegauges,sinebar,slipgauges,vernierbevelprotractor. **SurfaceTexture:**SurfaceRoughness,QuantitativeEvaluationofSurfaceRoughness andItsMeasurement. **Comparators:**Sigmacomparator,Johansson'sMicrokrator.	17

TextBooks:

- KumarD.S.,"*MechanicalMeasurementsandControl*",Metropolitan,N.Delhi.
- TayalA.K.,"*InstrumentationandMechanicalMeasurement*",GalgotiaPublishers.
- JainR.K.,"*Measurement&Metrology*",KhannaPublications.

ReferenceBooks:

- DobilinErnest,"*MeasurementSystemsApplicationandDesign*",TMH.
- Bewoor.,"Metrology&Measurement",TMHpublicationnewDelhi.
- KennethJohnHume.,"Engineeringmetrology",Macdonald.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

At theend of thiscoursestudentswill beableto

*CO1.Understandthemeasurementsystems,unitsanddimensionsandcharacteristicsofmeasuringinstruments.**(Understand)***

*CO2.Explainthevariousformmeasurementslikestraightness,flatness,roundness.**(Understand)***

*CO3. Understand working of suitable instruments for typical measurements like strain, force andtorque.**(Understand)***

CO4. Identifymethodsanddevicesformeasurementoflengthand

*angle.**(Understand)**CO5.Understand concepts of limits, fits and tolerances in industrial*

*application. **(Apply)**CO6.Designoflimitgauges.**(Apply)***

*CO7.Determineandmeasureofsurfaceroughness.**(Understand)***

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	PSO/PO
CO1	PSO1/PSO2/PSO3/PO1/PO6
CO2	PSO2/PSO3/PO1/PO2/PO6
CO3	PSO2/PSO3/PO1/PO2/PO6
CO4	PSO2/PSO3/PO1/PO2/PO3/PO6
CO5	PSO2/PSO3/PO1/PO5
CO6	PSO3/PO1/PO3/PO5
CO7	PSO2/PSO3/PO1/PO3/PO5

BME C0801MEASUREMENTANDMETROLOGYLAB

Objective: *Toeducatestudentsondifferentmeasurementinstrumentsandoncommontypesof errors.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**ListofExperiments:** • ToFind OuttheErrorinthemeasurement ofthegivenspecimenUsingVernierCaliper. • ToAnalyzedtheDeviationinDiameterofAGivenSpecimenUsin g Micrometer. • ToMeasuretheAngleofAGivenSpecimen(WoodenBlock)Usin g SineBarandSlipGauges. • To Study the Limit Gauge For Better Understanding of Limits,Fits andTolerances. • ToObservetheAngularMeasurementsofAGivenSpecimenUsi ng VernierBevelProtector. • ToPerformStrainMeasurementinCantileverBeamUsingStrainGa ugeByApplyingtheDifferentLoads. • ToFind OuttheCircularityofACylindricalRodUsingDialGaugeIndic atorandV-Block. • ToFindOuttheSpeed ofAnyRotatingPart(I.E.,CeilingFan)Using Stroboscope(Non-ContactDevice). • ToMeasuretheHeightofAGivenSpecimenUsingHeightGauge. • ToDeterminetheTemperatureofAHeat BathUsingResistanceTypeDetector(RTD) andThermocouple. • ToMeasuretheLinearDisplacementUsingLinearVariableDif ferentialTransformer(LVDT). • ToMeasurethePressureUsingBourdonGaugeandStrainGauge. • To Determine the Torque of A Rotating Shaft Using Strain GaugeCoupledWithTorqueSensor. • ToFindOuttheFlatnessofASurfacePlateUsingSpiritLevel. • To determine the various elements of a threaded specimen withthehelpof profileprojector.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *At theend of thiscoursestudentswill beableto*

CO1.UnderstandanddetermineerrorinthemeasurementusingVerniercalliperandMicrometer. ***(Understand)***

CO2.DetermineangleusingsinebarandVernierbevelprotractor. ***(Understand)***

CO3. Understand limits,fitsandtolerancesusing limit gauges. ***(Apply)***

CO4. Understand theconcept ofcircularityusingcircularitytestonVblockand dialgauge.

(Understand)

*CO5.Determinetheelementsofathreadedspecimenwiththehelpofprofileprojector.**(Apply)***
*CO6. Determinespeedofrotatingpartusing noncontactabledevice.**(Understand)***

CO7.UnderstandworkingofLVDT,RDT,Thermocouples,straingaugeandbourdongauge.
(Understand)

*CO8. DetermineheightusingVernierheightgauge.**(Understand)***

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	PSO/PO
CO1	PSO2/PSO3/PO1/PO3/PO5/PO6
CO2	PSO2/PO1/PO3/PO6/PO5
CO3	PSO2/PSO3/PO1/PO5
CO4	PSO2/PSO3/PO1/PO3/PO5/PO6
CO5	PSO2/PSO3/PO1/PO3/PO5
CO6	PSO1/PSO2/PSO3/PO1/PO5
CO7	PSO1/PSO2/PSO3/PO1/PO3/PO5/PO6
CO8	PSO2/PSO3/PO1/PO5

BMEC0004HEAT&MASSTRANSFER

Pre-requisite:*AppliedThermodynamics*

Objective:*Todeveloptheunderstandingofbasicofheattransfermechanismandtheirapplicationinindustry.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Heat Transfer:** Basic concepts of heat transfer, Effect ofTemperature on Thermal Conductivity of Materials; Introduction to CombinedHeatTransferMechanism,EngineeringApplicationsofHeatTransfer. **Conduction:** Fourier's law of heat conduction for homogeneous, isotropicmedia, One-Dimensional General Differential Heat Conduction Equation in theRectangular, Cylindrical and Spherical Coordinate Systems (Case of constantthermal conductivity); Significance of thermal diffusivity, Initial and BoundaryConditions. **SteadyStateOne-DimensionalHeatConduction:**CompositeSystemsinRectangular, Cylindrical and Spherical Coordinates With and Without EnergyGeneration;ThermalResistanceConcept;AnalogyBetweenHeatandElectricityFlow;ThermalContactResistance;CriticalThicknessofInsulation. **ExtendedSurfaces(Fins):**Introduction,types,Generalequations,Finefficiencyandeffectiveness,FinsofUniformCross-SectionalArea,Finapplications. **Transient Conduction:** Transient Heat Conduction; Lumped CapacitanceMethod; Non-dimensional numbers in conduction – Significance of Biot andFouriernumbers,TimeConstant;UnsteadyStateHeatConductioninOneDimensionOnly,HeislerCharts. **NaturalConvection:**PhysicalMechanismofNaturalConvection;Characteristic Length,Non-dimensionalnumberswiththeirsignificanceEmpirical Heat Transfer Relations for Natural Convection Over Vertical PlanesandCylinders,Horizontal PlatesandCylinders.	20
II	**ForcedConvection:**BasicConcepts;HydrodynamicBoundaryLayer;ThermalBoundaryLayer;energyequation,ConcentrationBoundaryLayerNon-dimensionalnumberswiththeirsignificanceLocalandaverageheattransfer coefficients, Flow Over a Flat Plate; Empirical Heat Transfer Relations;**Radiation:**GrayBody;ShapeFactor;Black-BodyRadiation;RadiationExchange Between Diffuse Non Black Bodies in An Enclosure; Radiation Shields;Radiation from cavities, Electrical Analogy of Radiation Heat Transfer; SolarRadiation. **Heat Exchanger:** Introduction ,Types of Heat Exchangers; Fouling Factors;OverallHeatTransferCoefficient;Analysisofheatexchangers:LogarithmicMeanTemperatureDifference(LMTD)Method;Correctionfactorcharts,Effectiveness-NTUMethod;,HeatPipes **CondensationandBoiling:**IntroductiontoCondensationPhenomena;Dropwise Condensation;BoilingModes, Pool Boiling;	20

TextBooks:

- YadavR.,"*HeatTransfer*",CentralPublishingHouse,Allahabad,2018
- Rajpoot,R.K."HeatandMassTransfer",S.ChandPublications,2018
- D.S.Kumar,"HeatandMass Transfer"S.KKataria&sons, 2008

ReferenceBooks:
- Bayazitouglu&Ozisik,“*ElementsofHeattransfer*”,T.M.H.,2015
- HolmanJ.P.,“*HeatTransfer*”,McGraw-HillInternationaledition.2016
- Pitts&Sisson,“*Schaum'soutlineofHeatTransfer*”,McGraw-HillInternationaledition,2018
- FrankKreith,“*PrinciplesofHeatTransfer*”,McGraw-HillBookco.,2019

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletionofcourse,thestudents will beableto:
- DeterminetheoverallthermalconductivityofcompositewallofaFurnace.
- Determinethe criticalthicknessofinsulationofsteampipesofthermalpowerplant.
- EvaluatetheeffectivenessandefficiencyofheattransferofFinsofmotorbikeengine.
- Determinetheheattransfereffectivenessofshellandtubeheatexchangers.
- Understandmassdiffusion rateincaseofevaporativecooling incoolingtowers.
- Understandthe effectsoffoulinginboilertubesofthermalpowerplant.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO1
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO1,PO2/PSO1,PSO2
CO6	PO1,PO2/PSO1,PSO2

BME C0802HEATANDMASSTRANSFERLAB

Objective: *Heat Transfer is one of the important subjects which is commonly applied in renewable energy,industrial, commercial and domestic systems. The experiments are designed to provide exposure of practicalaspects of the various theoretical concepts developed under the course, Heat and Mass Transfer. The laboratoryconsistsofexperimentsonvariousconductive,convective,radiative,boilingmechanismsofheattransfer.*

Credits:01 **SemesterV** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments • ToDeterminetheOverallHeatTransferCoefficientForaCompositeWall • TodeterminethethermalConductivityofaMetallicRod andDraw a Graph Between Variation in Conductivity andTemperature. • To Determine the Heat Transfer Rate Through the CompositeCylinder and the Overall Heat Transfer Coefficient of CompositeSystem • ToDeterminethethermalConductivityofLiquid • ToDeterminethethermalContactResistanceofaCompositeWall • ToDeterminetheCriticalThicknessof insulationofaLaggedPipe. • To Determine the Heat Transfer Through a Heat Pipe & Draw aTemperatureDistributionProfileUnderSteadyStateCondition • To Determine the Heat Transfer & Temperature DistributionAlong a Uniform Cross- Section Fin Under Steady State in FreeConvection. • To Determine the Heat Transfer & Temperature DistributionAlongaUniformCross-SectionFinUnderSteadyStateinForcedConvection. • ToDeterminetheSpecificHeat ofAirunderSpecifiedatmosphericConditions. • ToDeterminetheCriticalHeatFlux Through aGivenWire(NichromeWire)in aPoolBoilingProcess. • To Determine the Heat Transfer & Overall Heat TransferCoefficientinaCounterFlow&ParallelFlowHeatExchanger. • ToDeterminetheStefanBoltzmannConstantUnderGivenCondition. • ToDeterminetheEmissivityofATestPlate. • ToDeterminetheViewFactor/ShapeFactorofAGivenArrangement.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COURSEOUTCOMES: Aftercompletionofcourse,thestudentswillbeableto:

- *CO1*Determine theoverallthermalconductivityofcomposite wallofaFurnace.
- *CO 2*Determinethe criticalthickness ofinsulationofsteampipes ofthermalpowerplant.
- *CO3*Evaluatetheeffectivenessandefficiencyofheattransfer ofFinsofmotorbikeengine.

- *CO4*Determinetheheattransfereffectivenessofshellandtubeheatexchangers.
- *CO5*Understandmassdiffusionrateincaseofevaporativecoolingincoolingtowers.
- *CO6* Understandtheeffectsoffoulingin boiler tubesofthermalpowerplant.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO1
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO1,PO2/PSO1,PSO2
CO6	PO1,PO2/PSO1,PSO2

BMEC0005FLUIDMECHANICS

Objective: *It is major branch of mechanics. It introduces students about fluid and its difference with solids.Geometry of fluid flow can be visualized. Its importance lies in its wide ranging applications in fluid powerengineeringandmechanicsoffluidflow.Italsodiscussesvariousempiricalrelationswhicharehelpfulinboundary layerapplications.Itprovidesbasisforcomputationalfluiddynamics.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Fluid and Continuum, Physical Properties of Fluids,Rheologyof Fluids. **Dimensional Analysis and Hydraulic Similitude:** DimensionalAnalysis,Buckingham's PiTheorem,ImportantDimensionless Numbersand Their Significance, Geometric, Kinematic and Dynamic Similarity,Model Studies. **Fluid Statics:** Pressure-Density-Height Relationship,Manometers, Pressure Transducers, Pressure on Plane and CurvedSurfaces, Centre of Pressure, Buoyancy, Stability of Immersed andFloating Bodies. **KinematicsofFluidFlow:**TypesofFluidFlows:Continuum&FreeMolecular Flows.SteadyandUnsteady,UniformandNon-Uniform,LaminarandTurbulentFlows,RotationalandIrrotationalFlows,Compressible and Incompressible Flows, Subsonic, Sonic and SupersonicFlows, Sub-Critical, Critical and Supercritical Flows, One, Two and ThreeDimensionalFlows, Streamlines,ContinuityEquationFor3Dand1DFlows,Circulation,StreamFunctionandVelocityPotential.	20
II	**Dynamics of Fluid Flow:** Euler's Equation of Motion Along A Streamlineand Its Integration, Bernoulli's Equation and Its Applications-Pitot Tube,OrificeMeter,VenturiMeterandBendMeter,NotchesandWeirs,MomentumEquationandItsApplication toPipeBends. **Laminar and Turbulent Flow:** Equation of Motion For Laminar FlowThrough Pipes, Stoke's Law, Transition From Laminar to Turbulent Flow,TypesofTurbulentFlow,MixingLengthConceptandVelocityDistributioninTurbulentFlowOverSmoothandRoughSurfaces,ResistancetoFlow,MinorLosses,PipeinSeriesandParallel,PowerTransmission ThroughAPipe,Siphon,WaterHammer. **Boundary Layer Analysis:** Boundary Layer Thickness, Boundary LayerOver A Flat Plate, Laminar Boundary Layer, Application of MomentumEquation, Turbulent Boundary Layer, Laminar Sublayer, Separation andIts Control,Drag and Lift, Drag on A Sphere, A Two Dimensional Cylinder, and An Aerofoil,Magnus Effect,Kutta-Jonkowski Theorem.	20

TextBooks:

- BansalR.K.,"*FluidMechanics*",LaxmiPublications.2016.
- Modi,P.N.,andSeth,S.H.,"*HydrualicsandFluidMachines*",StandardBookHouse,2010.
- AgarwalS.K."*FluidMechanics&Machinery*",TMH,2010.
- GuptaVijayandGuptaS.K.,"*Fluid Mechanicsand itsApplications*",WileyEasternLtd,1984.

ReferenceBooks:

- NarasimhanS., "*FirstCourseinFluid Mechanics*", UniversityPress,2012.
- Som,S.K.& BiswasG.,"*Introductionoffluid mechanics&Fluid Machines*", TMH,2000.

- DasM.M.,“*FluidMechanics&Turbomachines*”,OxfordUniversityPress,2013.
- Garde,R.J.,“*Fluid MechanicsthroughProblems*”, NewAgeInternationalPvt. Ltd,NewDelhi,2015.
- Shames,I.H.,“*MechanicsofFluids*”,McGrawHill,Int.Student,Education,2017.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:*Onlearningthissubject studentswillbeableto:*

- *CO1*:Identifyandobtainthevaluesoffluidpropertiesandrelationshipbetweenthem.
- *CO2:*Understandtheprinciplesofcontinuity,momentum,andenergyasappliedtofluidmotions.
- *CO3*:Calculatehydrostaticforceonsubmerged surfaceinastaticfluid.
- *CO4*: Calculatebuoyancyforce tounderstandthestabilityconceptofthefloatingbody.
- *CO5:* Applydimensionalanalysistopredictphysicalparametersthatinfluencetheflowinfluidmechanics inengineeringapplications.
- *CO6*:Relate fundamentalsoffluidmechanicstothewidespectrumofreal lifeproblems.
- *CO7*: Tacklereal lifeproblemsrelatedtosupplyanddistributionoffluidindomesticandindustrialsector.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2,PO3/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2,PO3/PS1
CO4	PO1,PO2,PO3/PS1
CO5	PO1,PO2,PO3/PS1
CO6	PO1,PO2,PO12/PS1
CO7	PO1,PO2,PO12/PS1

BMEC0803FLUIDMECHANICSLAB

Objective: *This lab is runin conjunctionwith thetheory course.Itis an introductory course where flowbehavior, fluidforcesandanalysistoolsareintroduced.It coversmeasuringdevicesandtechniques, erroranalysis in experimental works and analysis of assumptions in the theory of fluid mechanics. The laboratoryprovidestrainingtoundergraduateandgraduatestudentsinflowmeasurements.*

Credits:01 **L–T–P:0–0–2**

Modul eNo.	Conten t	Teachin gHour s
I	**ListofExperiments:** • ToDetermineCoefficientofDischargeofGivenShapeofOrifice. • To Determine Coefficient of Discharge of Given Shape ofVenturimeter. • ToDemonstratetheTransitionFromLaminartoTurbulentFlowand toDetermineLowerCriticalReynoldsNumber. • ToDeterminetheLossofHeadsforPipeFittings. • ToDetermineCoefficientofDischargeofGivenShapeofMouthPiece. • ToDeterminetheMetaCentricHeight oftheGiven ShipModelExperimentally. • ToDetermineCoefficient ofDischargeofAGivenShapeofV-Notch. • ToVerifyBernoulli'sTheoremExperimentally. • ToStudytheBoundaryLayerVelocityProfileOverAFlat PlateandtoDeterminetheBoundaryLayerThickness. • ToVerifyMomentumTheoremUsing MomentumTheoremApparatus. • ToDetermineCoefficientofDischargeforFlowOverARectangularWeir. • ToDeterminetheFrictionFactorforFlowThroughPipes • VirtualDemonstrationofVelocity,ViscosityandPressureMeasuring Devices.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Onsuccessfulcompletionofthecourse,thestudentwillbeableto,

- *CO1:Enhancetheirknowledgeofbasicprinciplesoffluidmechanics.*
- *CO2:Analyzefluidflowproblems withtheapplicationofthemomentumand energyequations.*
- *CO3:Understandbasicworkingprinciplesofvariousflowsandpressuremeasuringequipmentslikemouthpiece,orificenotchesandweirs.*
- *CO4:usethetechniques,skillsandmodernengineeringtoolsnecessaryforfluidengineeringpractice.*
- *CO5:EvaluatetheMetacentricheightofsubmergedbodiestounderstandthestabilityconcept.*
- *CO6:Estimatetheminorandmajorfrictional lossesinpipeflow.*
- *CO7:VerifytheconceptofBernoulli'sequationinpipeflowexperimentally.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2,PO3/PS1
CO4	PO1,PO2,PO5/PS1
CO5	PO1,PO2,PO3/PS1
CO6	PO1,PO2/PS1
CO7	PO1,PO2/PS1

BMEC0006MANUFACTURINGSCIENCE–I

Pre-requisite:*Material Science*

Objective:*Toimpart thecomprehensiveinsight intovariousmanufacturingprocessessuchasmetalcasting,sheetmetal,weldingandadvancedweldingprocesses.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching hours
I	**Introduction:**ImportanceofManufacturing,ClassificationofManufacturing ProcessesandItsApplications. **Casting:**PatternDesign&Allowances.Gating,Riser,Runners,MoldingParametersandDesign,SolidificationofCasting,GatingSystemDesign,SandTestingMethods,CastingDefectsandRemedies.DieCasting,CentrifugalCasting,InvestmentCasting,Carbon Di-OxideCasting, **SheetmetalProcessing:**TypesofPressDie,Simple,Progressive,Compound and Combination. Punch & Die Clearance. Blanking & Piercing,CuttingandPunchingMechanism.MethodofReducingCuttingForces. Bending of Strip&SpringBack. **Welding:** Introduction and Concept of various Welding Processes, ElectricArcWeldingResistanceWelding,AtomicHydrogenWelding,GasWelding.	21
II	**Advanced Welding Processes:**Electron Beam Welding and Plasma arcWelding Process. Laser beam welding and diffusion Welding, Heat AffectedZone(HAZ)MetallurgicalAspectsofWeldJoint,WeldingDefectsandRemedies,SolidStateWeldingProcesses,FrictionWeldingProcess,ExplosiveWelding. **Metal Forming:** Metal Deformation, Yield Criteria. Concept of Inter-FacialFriction and Lubrication Mechanism in Manufacturing. Determination andCalculation of Pressure Distribution With Sliding Friction for Drawing andExtrusion of Wire/Strip, Conditions for Rolling, Force and Power in Rolling,Limiting ThicknessandReduction. **AdvancedMetalFormingProcesses:**UnconventionalMetalFormingProcesses- Explosive Forming, Electromagnetic Forming, Electro-HydraulicForming,Hydro-StaticExtrusion,Hydro-DynamicWire Drawing,ConceptandApplicationsofPowderMetallurgy.	21

RecommendedBooks:

- Sharma P.C.,“*ManfacturingEngineering*”,S.ChandNewDelhi
- GrooverM.P., “*ManufacturingProcess:MaterialsofSystems*”,John Wiley&Sons,Inc.
- Serope**Kalpakjian,**“*ManufacturingProcess*”,AddisonWesleyPublishingCo.
- GhoshandMalik,“*Manufacturingscience*”,EastWestPvt.Ltd.
- Boothroyd, “*FundamentalofMetalCutting and MachineTools*”, John Wiley& Sons,Inc.
- OstwaldPhillipF.,“*ManufacturingProcess*”,JohnWiley&Sons,Inc.
- DeGarmo,“*Materials&Manufacturing*”,WileyPublications.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcomes:

Students areexpectedtolearn:

Oncompletionofthiscourse,thestudents wouldbeableto:

CO1.Thestudentwillbehavingthecapability ofselectingsuitablemanufacturingprocessestomanufacturetheproductsoptimally.

CO2.Thestudent willabletounderstandthevariousmetalcasting methods,designingofriserandgatingsystemalongwithcastingdefectsandtheiranalysis.

CO3.Thestudentwillbeabletorecommendtheappropriatedesignofgatingsystems,formingprocesses,Sheet metaloperations.

CO4.Thestudentwillabletounderstandthetypesofweldingaccordingto materialsapplicationandvariousadvancedweldingmethodandthererequirementsandNDTtechniques.

CO5.Thestudentwillabletounderstandtheprocessingof variousconventionalandadvancedmetalformingprocessesandparameters.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos) andProgramOutcomes(PSOs):

CO	**POs/PSOs**
CO1	PO1,PSO2
CO2	PO3,PSO2
CO3	PO3,PSO2
CO4	PO1,PSO2
CO5	PO1,PSO2,PSO3

BMEC0804:MANUFACTURINGSCIENCE-ILAB

Objective: *The purpose of this lab is to enable the students to have the practical skills for basic manufacturingoperations e.g. Preparation of Sand, Making Pattern with allowances, Preparation of different types of mouldswith cores for various castings. The student will also have practical exposure to Press work and die assembly andmachining processes on various machine tools such as Spur gear on milling machine, knurling Bush on CapstanLatheandpreparationofSinglepointcuttingtoolonToolGrindingmachine.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**ListofExperiments-** • ToStudyand AnalyzeDifferent TypesofPatternsConsidering: (A) Shape(B) Size(C) PartingLine • ToDesignandFabricatethePatternforAGivenComponentConsidering Different Allowances and Surfaces Which RequireMachining. • To Make A Casting for Half Bush Gland By SelfHanging CoreMouldasPerGivenDimensions. • To Make A Casting for Hollow Step Pulley With the Help of GreenSandMould. • ToPreparetheBushGlandFromMetalByUseofDiesCastingMethod. • ToPrepareABarofCircularCrossSectionFromSquareBarKeeping LengthConstant. • ToPreparetheRing ByUsing theBending andForgeWeldingOperation. • ToMakeaWasherbyUsing Combination DieandtoStudyHowProgressiveDieisDifferentfromCombination Die. • ToAnalyzetheFlowPatternDuringTubeBendingProcess. • To Analyze the Flow Pattern and Die Load During DirectExtension Process By Using Dies of Different Shapes and CrossSectionDuring: (A) DifferentReductionRatio(B)DifferentShapes • ToMakeA 10T.P.I.(R.H.) Thread on M.S.BarforHexagonalBoltWiththeHelp ofCentreLatheMachineas PerGivenFigure. • To Make A Cast Iron Block and Make A Key Way on Its SurfaceWiththeHelp ofShaperMachineas PerGivenFigure. • ToMakeAPlain(Spur)Gearof10TeethonMillingMachineasPerGivenFigure. • ToMakeAKnurling Bushon CapstanLatheasPerGivenDimensions andSketch. • ToMakeASinglePoint CuttingToolAnglesWiththeHelpofToolGrindingMachineA PerGivenDimensions and Sketch.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *On successful completion of this lab, the students will be able to:CO1:Demonstrateanunderstandingofandcomplywith FoundryShop; CO2:Abletousetoolsformouldpreparation,coresformanufacturingthecastingobjects;CO3:Iden*

tifythedefectsproducedincastings;
CO4:AbletogaintheknowledgeofbasicoperationofHandForging;CO5:
Able to perform the basic operations of Hand press
machine;CO5:Abletoperform theoperationson LatheMachineTool;
CO6:AbletogaintheoperationalknowledgeofShaperandMillingMachineTool.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO3,PSO3
CO2	PO1
CO3	PO1
CO4	PO1,PO3
CO5	PO1
CO6	PO1,PO3,PSO3

BMEC0007STRENGTHOF MATERIALS

Pre-requisite:*AppliedMechanics*

Credits:03 L–T–P:3–0–0

Module No.	Content	Teaching Hours
I	**Stress and Strain:** Simplestress, typesof stressesand strains, hook'slaw,principle of superposition, Elastic constants, bars of varying section, uniformlytaperedbars,elongationofbarduetoself-weight,compoundbars,Indeterminatestructures,Thermalstressesinuniformbars .Strainenergy,impactloading. **Simple Bending of Beams:** Theory and assumptions of Pure Bending, Stressesin Beams Under Different Types of Loads, Beam of uniform strength, Directshearstressesin beams. **Torsion:** Torsion of Circular shafts, design of shaft, stress and strain in pureshear,Staticallyindeterminatetorsionalmember,strainenergyintorsion. **Slope and Deflection of Beams:** Slope and Deflection of Statically DeterminateBeamsUsingMacaulay'sMethod,Area-Moment andCastigliano'sTheorem.	22
II	**Compoundstressandstrain:**Introduction,planestress,principleplanes,principle stresses and maximum shear stresses, Mohr's circle for plane stress,hook's law for plane stress, tri-axial stress, transformation equations for planestress, plane strain. **Theories of Elastic failures:** Rankine's theory, St. Venenttheory,Guest'stheory,Haigh'stheory,Maximumdistortionenergytheory,graphicalrepresentationandtheircomparison. **Columns:** Euler's Theory of Buckling of A Column, Middle-Third and Middle-Quarter Rules, End Conditions For Columns, Different Empirical Formulae ForColumns. **PressureVessels:**StressesandStrainsinThinandThickCylindersandSpheresSubjected toInternalandExternalPressures. **Springs:**DeflectionofHelicalSprings(opencoilandclosedcoil)UnderDifferentTypesofLoads,Springs inSeriesand Parallel,LeafSprings.	24

TextBook

- L.S.Shrinath, "MechanicsofSolids":TataMcGraw-HillPublication,2009.
- B.J.Goodno andJ.M. Gere,"Mechanicsof materials, 9e":CenageLearning,2018.
- B.C.Punamia, A.K.JainandA.K.Jain, "Mechanicsofmaterials": LaxmiPublication,2017.
- R.K.Rajput,"ATextbookof StrengthofMaterials(MechanicsofSolids)inSIUnits7e":SChand,2018.

ReferenceBooks:

- G.H.Ryder,"StrengthofMaterials":MacmillanPublishersIndiaLimited,2002.
- S. P. Timoshenko and D. H. Young, "Elements of Strength of Materials": Affiliated East-West Press,2003.
- F.P.Beer and E.R.Johnston, "MechanicsofMaterials(SIE)7e":McGrawHillEducationIndiaPrivate Limited,2017.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: After completion of course, the student will be able to:

CO1:Understandtheconceptsofstressandstrainatapointaswellasthestress-strainrelationshipsforhomogenous,isotropicmaterialsand**classify**thetheoriesof failureforstatic loading.

CO2:Calculatethestressesandstrainsinaxialloading,bendingofbars,circulartorsionmembers,andmembersubjecttoflexuralloadingsandmemberssubjected tocombined loading.

CO3:Draw ShearForceandBendingMomentdiagramsofvarioustypesofbeamssubjectedtodifferentloads.

CO4:Determinetheslopeanddeflectionsproducedbythethreefundamentaltypesofloads:axial,torsional,andflexural.

CO5:Computeand**illustrate**theprincipalstresses,maximumshearingstress,andthestressesactingonastructuralmember.

CO6:Calculatethestressesandstrainsassociatedwiththin-wallsphericalandcylindricalpressurevessels.

CO7:Understandthephenomenonofbucklingofcolumnsand**calculate**thecriticalloadforslender,longcolumnssubjectedtoaxial loads.

MappingofCourseOutcomes(COs)withProgram outcomes(POs)andProgram SpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO3,PO4/PSO3
CO5	PO2,PO3/PSO3
CO6	PO2,PO3,PO4/PSO3
CO7	PO2,PO3/PSO3

BMEC0008KINEMATICSOFMACHINES

Pre-requisite:*AppliedMechanics*
Objective:*Toexplainvariousgoverninglawstounderstandmechanism,todevelopmachinesbasedonsimplemechanismandunderstandforcesinvolved.Tounderstanddifferenttypesofgearsbasedonlinkmechanisms*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:**Definitions:Link,kinematicpairs,kinematicchain,mechanism,structure,degrees of freedom, Classification links, Classifiction of pairs based on type ofrelativemotion,Grubler\'scriterion,mobilityofmechanism,Groshoff'scriteria,inversionsofFourBar ,SingleSliderandDouble SliderCrank. **SPECIAL MECHANISMS:** Exact Straight Line Motion Mechanisms - Peaucellier's, Hart andScottRussellMechanisms,ApproximateStraightLineMotionMechanisms–Grass-Hopper, Watt and Tchebicheff Mechanisms, Pantograph, Condition for correct steering,DavisandAckermansteeringgearmechanism. **Velocity and Acceleration Analysis of Mechanisms:** Velocity and acceleration analysisofFourBarmechanism,slidercrankmechanismandSimpleMechanismsbyvectorpolygons:Relativevelocityandaccelerationofparticles.inacommonlink,relativevelocity and accelerations on separate links- Coriolis component of acceleration. Angularvelocityandangularaccelerationoflinks,velocityofrubbing.	22
II	**Velocity Analysis by Instantaneous Center Method Klein's Construction:**VelocityAnalysisbyInstantaneousCenterMethod:Definition,Kennedy'sTheorem,Determination of linear and angular velocity using instantaneous center method Klein'sConstruction:Analysisofvelocityandaccelerationofsingleslidercrankmechanism. **SpurGears**:Gearterminology,lawofgearing,pathofcontact,arcofcontact,contactratio of spur gear. Interference in involute gears, methods of avoiding interference, forminimum number of teeth to avoid interference, Simple gear trains, compoundgeartrains. Epicyclic gear trains: Algebraic and tabular methods of finding velocity ratio ofepicyclic gear trains, torque calculation in epicyclic gear trains.**Cams:** Types of cams, types of followers. displacement, velocity and acceleration curvesvelocity, Simple Harmonic Motion, Uniform Acceleration Retardation, Cycloidalmotion.Camprofiles:disccamwithreciprocating/oscillatingfollowerhaving,roller andflat- facefollowerinline.	18

TextBooks:

- S.S.Ratan,"TheoryofMachines5e":TataMcGraw-HillPublication,2019.
- J.K. GuptaandR.S. Khurmi, "TheoryofMachines14e":SChand& CoLtd,2005.
- R.K. Bansal and J. S.Brar,"ATextbookofTheoryofMachines5e":LaxmiPublishers, 2016.

ReferenceBooks:

- J. J. Uicker, G. R. Pennock and J. E. Shigley, "Theory of Machines and Mechanisms": Oxford UniversityPress,2014.
- A.GhoshandA.K. Mallik,"TheoryofMachinesandMechanisms":Eastwestpress,2008.
- P.L.Ballaney,"Theoryofmachines &Mechanism": JohnWileyPublishers,2005.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Afterstudyingthissubjectstudentswillbeableto:*

- **CO1:**Computetheforcesandtorquesinvolvedinfrictiondriveslikescrewthreads,clutches,belts,ropesand bandandblockbrakes.
- **CO2:**Designapossiblegeartrainanddeterminethespeeds ofsimple,compoundandepicyclicgeartrains.
- **CO3:**Sketchslowspeedandhighspeedcamprofilefortherequiredpredefinedmotionoffollower.
- **CO4:**Analyzevelocityandaccelerationofmechanisms.
- **CO5:**Calculatekinematicpropertiesofsimpleplanarmechanismsusinggraphicalapproach,instantaneous centermethodandsynthesisthemat elementarylevel.
- **CO6:**Modelplanarmechanismswhichwillhavedefinedrequired motion.

MappingofCourseOutcomes(COs)withProgram outcomes(POs)andProgram SpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO3/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO2/PSO3
CO5	PO2,PO3/PSO3
CO6	PO2,PO3/PSO3

BMEC0009:DYNAMICSOFMACHINES

Pre-requisite:*KinematicsofMachine*
Objective: *The objective of this course is to provide the details of the concepts of generalized forces and Staticand dynamic force analysis, concepts of static and dynamic mass balancing. To introduce the approaches andmathematical models used dynamical analysis of machinery. To teach students concepts of free Vibration ofSingle Degree ofFreedomSystems,VibrationMeasurementandApplications, Modal Analysis.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Static and Dynamic Force Analysis:** Static equilibrium. Equilibrium of twoand three force members. Members with two forces and torque. Free bodydiagrams. Static force analysis of four bar mechanism. Dynamic force analysisofSlider Crankmechanism. **TurningMoment&Flywheel:**TurningMomentonCrankshaft,TurningMoment Diagrams- Four Stroke IC Engine and Multi-Cylinder Steam Engine,FluctuationofEnergy,Flywheel. **BalancingofRotatingandReciprocatingMasses:**StaticandDynamicBalancing, Balancing of Several Masses in the Same Plane and Different Planes,BalancingofReciprocatingMasses,BalancingofPrimaryForceinReciprocatingEngine,PartialBalancingofTwoCylinderLocomotives,Variationof TractiveForce,SwayingCouple,HammerBlow. **Governors:** Terminology, Centrifugal Governors-Watt Governor, Dead WeightGovernors-Porter&ProellGovernor,SpringControlledGovernor-HartnellGovernor,Sensitivity,Stability,Hunting,Isochronism,EffortandPowerof Governor,ControllingForceDiagramsforPorterGovernorandSpringControlledGovernors.	20
II	**Friction:**PivotsandCollarFriction-UniformPressureandUniformWear,Frictional, Centrifugal Clutches,Belt and Pulley Drive, Length of Open andCrossBeltDrive,Ratio ofDrivingTensionsfor FlatBeltDrive,CentrifugalTension, ConditionforMaximumPowerTransmission,V BeltDrive. **Gyroscopic Motion:** Gyroscopic Torque, Effect of Gyroscopic Couple on theStabilityofTwo WheelerandFourWheeler, Ships andAero-Planes. **MechanicalVibrations:**TypesofVibrations,DegreesofFreedom,Single Degree Free & Damped Vibrations, Forced Vibration of Single Degree SystemUnderHarmonicExcitation, Critical SpeedsofShaft.	20

TextBooks:

- RattanS.S.,“TheoryofMachines”,TMH.
- BallaneyP.L.,“TheoryofMachines”,KhannaPublication.
- Khurmi&Gupta,“TheoryofMachines”, S.ChandandCompanyLtd.,.NewDelhi.
- BansalR.K.,“TheoryofMachines”,LaxmiPublishers.
- SinghV.P.&ChandS.,“TheoryofMachines”,DhanpatRai&Sons.

ReferenceBooks:

- BevanThomas,“TheoryofMachines”,CBSPublishersandDistributors.
- Shingle,“TheoryofMachinesandMechanisms”,McGraw–HillInternationalEditions.
- Ghosh&Mallik,“TheoryofMachinesandMechanisms”,Eastwestpress.
- Rao&Dukkipati,“TheoryofMachinesandMechanisms”,Eastwestpress.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletingthis coursethestudentwillbeableto:

- **CO 1:** Take notice of importance of the balancing and learn procedures of the static anddynamicbalancing.
- **CO2:**Understandtheimplicationsofcomputedresultsindynamicstoimprovethedesignofa mechanism.
- **CO3:**Understandtheconceptofwhirlingofshaft,effectofgyroscopiccoupleonaeroplane.
- **CO4:**Practicallyknowhowthegovernorapparatusworks.
- **CO 5:** Determine the natural frequencies of continuous systems starting from the generalEquationof displacement.
- **CO6:**Understandthevarioustypesofvibratorymotions.

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)andProgrammeSpecific Outcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1
CO2	PO1,PO2,PO3,PO4/PSO1,PSO3
CO3	PO1,PO2,PO4/PSO3
CO4	PO1,PO6,PO8/PSO3
CO5	PO1,PO2,Po3,PO9/PSO1
CO6	PO1,PO2,PO4,PO12/PSO1

BMEC0805:THEORYOFMACHINESLAB

Objective: *ObjectivesofthisTheoryofMachineslabaretoimpartpracticalknowledgeondesignandanalysisof mechanisms for the specified type of motion in a machine. With the study of rigid bodies motions and forces forthe transmission systems, machinekinematics and dynamics canbe wellunderstood. Demonstration exercisesare provided with wide varieties of transmission element models to understand machine kinematics. Variousexperiments with governors, gyroscopes, balancing machines and universal vibration facilities are available tounderstandmachinedynamics.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments • StudyofSimpleLinkageModels/MechanismsandVerificationofGrashoff'sCriteria ofFour BarLinkages. • DeterminationofVelocityRatioandVerificationofHoldingtorqueinEpicyclicGearTrains. • DeterminationofNaturalFrequencyinLongitudinalVibratingSystem. • DeterminationofNaturalFrequencyinTransverseVibrationSystem. • ExperimentalinvestigationoftheCharacteristicsofDeadWeightMechanicalGovernor. • ExperimentalinvestigationoftheCharacteristicsofSpringControlledGovernor. • DeterminationofCriticalSpeedinWhirlingofShafts. • Study of the Principles of Gyroscope and Verification of the EquationofGyroscopicCouple. • StudyoftheConceptofStatics&DynamicBalancingofRotatingMassesinSingleandMultiPlanesandVerificationofBalancingPrinciples. • Measurement of Slip in Flat Belt under Different Belt Tensions andVaryingLoadConditions.	

TextBooks:

- S.S.Ratan,"TheoryofMachines",TMH
- Khurmi&Gupta,"TheoryofMachines",S.ChandandCompanyLtd.,.NewDelhi.
- BansalR.K.,"TheoryofMachines",LaxmiPublishers.
- SinghV.P.&ChandS.,"TheoryofMachines",DhanpatRai&Sons.

ReferenceBooks:

- Shingle,"TheoryofMachinesandMechanisms",McGraw–HillInternationalEditions.
- Ghosh&Mallik,"TheoryofMachinesandMechanisms",Eastwestpress.
- Rao&Dukkipati,"TheoryofMachinesandMechanisms",Eastwestpress.
- Balani,"Theoryofmachines &Mechanism",JohnWileyPublishers.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletingthis coursethestudentwillbeableto:

- **CO1:**Understandtheconceptofwhirlingofshaft,effectofgyroscopiccoupleonaeroplane.
- **CO2:**Analyzethedifferenttypesofmechanisminvolvedinthemachines.
- **CO3:**Gatherknowledgeabouttheslipandcreepphenomena occurringinbeltdrives.

- **CO4:**Practicallyknowhowthegovernorapparatusworks.
- **CO5:**knowtheconditionofStaticanddynamicbalancing.
- **CO6:**understandthevarioustypesofvibratorymotions.

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)andProgrammeSpecific Outcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO3
CO2	PO1,PO2,PO9/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO6,PO8/PSO1
CO5	PO1,PO2/PSO1
CO6	PO1,PO2,PO12/PSO3

BMEC0010:MACHINEDESIGN–I

Pre-requisite: *StrengthofMaterials*
Objective: *Theobjectiveofthiscourseistointroducedesignconceptsandproceduresnecessarytodesignandselectamachinecomponent intermsofgeometryandmaterials,subjectedtostaticand/ordynamicload.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Mechanical Engineering Design,Design considerations, Standards inDesign,Material Selection. **Design Against Static Load:** Modes of Failure, Factor of Safety, Theories of Failure.**Design Against Fluctuating Loads:** Cyclic Stresses, Fatigue and Endurance Limit,Stress Concentration Factor, Design for Finite and Infinite Life, Soderberg, GoodmanCriteria. **Shafts:** Cause of Failure in Shafts, Materials for Shaft, Design of Shafts, Shafts SubjectedtoFatigue Loads. **Keys and Couplings:** Types of Keys, Splines, Design of Square & Flat Keys, Couplings-Designof RigidandFlexible Couplings.	20
II	**DesignofRivetedJoints:**TypesofRivetedJoints,FailureofRivetedJoint,EfficiencyofRiveted Joint,Designof BoilerJoints,EccentricLoadedRiveted Joint. **Design of Threaded Joint:** Design of Bolted Joint, Eccentrically Loaded Bolted Joint.**DesignofWeldedJoints-**StressesinButtandFilletWelds,EccentricallyLoadedJoint. **MechanicalSprings:**Materialfor HelicalSprings,Designof HelicalSpringsSubjectedtoStaticandFatigueLoading,Design ofLeafSpring. **PowerScrews:**FormsofThreads,MultipleThreads,EfficiencyofSquareThreads,TrapezoidalThreads,StressesinScrews,Designof ScrewJack. **Note:DesignDataBookIsAllowedin theExamination**	20

TextBooks:

- SharmaandAgrawal,"*MachineDesign*",S.K.Katara&Sons.
- BhandariV.B.,"*DesignofMachineElements*",TataMcGrawHillCo.
- ShigelyJosephE.,"*MechanicalEngineeringDesign*",McGrawHillPublications.

ReferenceBooks:

- ValanceAlexandDoughtieVI,"*DesignofMachineMembers*",McGrawHillCo.
- SpottM.F.,"*Machinedesign*",PrenticeHallIndia.
- MaleevandHartman,"*MachineDesign*",CBSPublications.
- Black&Adams,"*Machinedesign*",McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Attheendofthecourse,astudentwillbeableto*

- **CO1:**Analyzethestressesinmachineelementsandstructuralmembersundervariousloads.
- **CO2:**Applymultidimensionalfailurecriteriaintheanalysisanddesignofmachinecomponents.
- **CO3:**Understandthecausesofstructuraljointsfailures.
- **CO4:**Designandselectionofstructuralriveted,boltedandweldedjoints.
- **CO5:**Designanddeterminethefatiguelifeofcircularshaftsunderthecombinedloadings.
- **CO6:**Selectionofmechanicalkeys.
- **CO7:**Designofrigid&flexiblecouplings.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1, PO2/PSO1
CO2	PO3, PO4/PSO1
CO3	PO1,PO2,PO3/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO2,PO3/PSO1
CO6	PO1,PO2,PO3/PSO1
CO7	PO1,PO2,PO3/PSO1

BMEC0806:MACHINEDESIGN–ILAB

Objective: *The primary objective of this course is to demonstrate how engineering design uses the manyprinciples learned in previous engineering science courses and to show how these principles are practicallyapplied Estimate fatigue strengths of steel parts. Applytechniques of combined stress and Mohr's circle inmachine designsituations.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments **StudentsareAdvisedtoUseDesignDataBookFortheDesign.Drawing Shall be Made Wherever Necessary (Using CAD-SoftwareSuchasAutoCAD).** • Design&DrawingofCotterJoint. • Design&DrawingofKnuckleJoint. • DesignofMachineComponentsSubjectedtoCombinedSteadyandVariableLoads. • Design&DrawingofEccentricallyLoadedRivetedJoint. • Design&DrawingofBoiler RivetedJoint. • DesignofShaftforCombinedConstantTwistingandBendingLoads. • DesignofShaftSubjectedtoFluctuatingLoads. • Design&DrawingofFlangedTypeRigidCoupling. • Design&DrawingofFlexibleCoupling. • DesignofHelicalSpring. • DesignofLeafSpring. • DesignofHelicalSpringSubjectedtoFluctuatingLoad. • DesignofScrewJack. • DesignofEccentricallyLoadedWeldedJoint. • DesignofEccentricallyLoadedThreadedJoint.	

TextBooks:

- SharmaandAgrawal,“*MachineDesign*”,S.K.Katara&Sons.
- BhandariV.B.,“*DesignofMachineElements*”,TataMcGrawHillCo.
- ShigelyJosephE.,“*MechanicalEngineeringDesign*”,McGrawHillPublications.

ReferenceBooks:

- ValanceAlexandDoughtieVI,“*DesignofMachineMembers*”,McGrawHillCo.
- SpottM.F.,“*Machinedesign*”,PrenticeHallIndia.
- MaleevandHartman,“*MachineDesign*”,CBSPublications.
- Black&Adams,“*Machinedesign*”,McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: *At theend ofthecourse,a studentwill beable to*

- **CO1:**Understandtheconceptsofgeometricandsolidmodelling.
- **CO2:**DesignofMachineComponentsSubjectedtoCombinedSteadyandVariableLoads.

- **CO3:** Model and simulate the mechanical engineering parts and components which includeCotter Joint, Knuckle Joint, structural joints, shaft, spring & screw jack along with theirassemblyinaCAD package.
- **CO4:**Studentswillbeabletoidentifyandanalyzepracticalproblems.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1, PO5/PSO1
CO2	PO2, PO3/PSO1
CO3	PO3, PO5/PSO1
CO4	PO3, PO5/PSO1

BMEC0011:MACHINEDESIGNII

Pre-requisite:*MachineDesignI*
Objective: *The objective of this course is to introduce the guidelines for design of bearings, gears, to know thedesign process of different IC engine parts like cylinder head, piston, gudgeonpin, connecting rod, crank shaftetc.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**SpurGears:**ToothForms,StandardProportionsofGearSystems,Interference,SelectionofGearMaterials,BeamStrengthofGearTooth,DynamicToothLoad,WearStrengthofGear Tooth,Failure ofGearTooth,Designof SpurGears,AGMAandIndianStandards. **Helical Gears:** Beam Strength and Wear Strength of Helical Gears, Design ofHelicalGears. **BevelGears:**StressesinBevelGears,DesignofBevelGears. **Worm Gears:** Efficiency of Worm Gears, Heat Dissipation in Worm Gearing,Strengthand WearToothLoadforWorm Gears, DesignofWorm Gearing.	18
II	**Sliding Contact Bearing:** Selection of Bearing, Hydrodynamic Lubrication,Properties and Materials, Lubricants and Lubrication, Hydrodynamic JournalBearing, Design of Journal Bearing, Thrust Bearing-Pivot and Collar Bearing,Hydrodynamic ThrustBearing. **Rolling Contact Bearing:** Classification, Bearing Life, Reliability of Bearing,SelectionofRolling Contact Bearing,Lubrication,MountingofBearing. **ICEngineParts:**SelectionofICEngine,DesignConsiderations,Designof Cylinder and Cylinder Head; Design of Piston, Piston Ring and Gudgeon Pin;Designof ConnectingRod;Design ofCrankshafts.	22

TextBooks:

- SharmaandAgrawal,"*MachineDesign*",S.K.Katara&Sons.
- Bhandari,V.B.,"*DesignofMachineElements*",TataMcGrawHillCo.

ReferenceBooks:

- Shigely,JosephE.,"*MechanicalEngineeringDesign*",McGrawHillPublications.
- Valance,AlexandDoughtie,VI,"*DesignofMachineMembers*",McGrawHillCo.
- Spott, M.F., "*Machine Design*", Prentice Hall India.
- Maleev and Hartman, "*Machine Design*", CBS Publications.
- Black&Adams,"*MachineDesign*",McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheendofthecourse,astudentwillbeableto

- **CO1:**UnderstandthegeartoothsystemasperAGMAstandardsSpurGear,Helicalgear,BevelGear &wormgears.
- **CO2:**AnalyzetheforceactingonSpurGear,Helicalgear,BevelGear&wormgearsusedinpowertransmissionapplications.
- **CO3:**SelectthematerialandevaluateofstressesforSpurGear,Helicalgear,BevelGear&wormgearsused inpowertransmissionapplications.
- **CO4:**DesignandselectionofSpurGear,Helicalgear,BevelGear&wormgearsusingAGMAstandards andcatalogues.

- **CO5:**Understandthecausesofbearingfailures.
- **CO6:**Understandtheselectionofhydrodynamic,hydrostaticandrollingelementbearingsusedfor powertransmissionshafts.
- **CO7:**Designofhydrodynamic,hydrostaticandrollingelementbearingsusedforpowertransmissionshafts.
- **CO8:**Designcylinder,piston,connecting-rodandcrankshaftsusedinICengines.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO1
CO2	PO1, PO3/PSO1
CO3	PO1, PO3/PSO1
CO4	PO1,PO6,PO8/PSO1
CO5	PO2,PO3, PO4/PSO1
CO6	PO1, PO3/PSO1
CO7	PO1,PO2,PO3/PSO1
CO8	PO1,PO2,PO3/PSO1

BMEC0807:MACHINEDESIGN-IILAB

Objective: *Develop and evaluate alternatives for mechanical systems. Learn programming of design problems.Apply iterative techniques in design, including making estimate of unknown values for first computation andchecking or revising and re-computing. Design Gears, Bearings and IC engine. Learn Modeling and Analysis onSoftware.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	• DesignofSpurGear • DesignofHelicalGear • DesignofBevelGear • DesignofWormandWormGear • DesignofGearAssembly • DesignofProjectReportConsistsofDifferentTypesofGears • DesignofAntifrictionBearingAssembly • DesignofJournalBearing • DesignofProjectReportConsistsofDifferentTypesofBearings. • DesignofCylinderandCylinderHead. • DesignofPiston,PistonRingandGudgeonPin. • DesignofConnectingRod. • DesignofCrankshafts. • The Design Project Consists of Two Imperial Size Sheets Drawn With3D/2D CAD Software- One Involving Assembly Drawing With A PartList and Overall Dimensions and the Other Sheet Involving Drawingsof Individual Components, Manufacturing Tolerances, Surface FinishSymbols and Geometric Tolerances Should be Specified So as to MakeItWorkingDrawing.ADesignReportGivingAllNecessaryCalculations of the Design of Components and Assembly Should BeSubmitted. Students Are Required to be Submitted A Design Report Giving All NecessaryCalculationsofthe Designof ComponentsandAssembly. DevelopthePrograms in 'C'LanguageforAllDesignComponents.	

TextBooks:

- SharmaandAgrawal,"*MachineDesign*",S.K.Katara&Sons.
- Bhandari,V.B.,"*DesignofMachineElements*",TataMcGrawHillCo.

ReferenceBooks:

- Shigely,JosephE.,"*MechanicalEngineeringDesign*",McGrawHillPublications.
- Valance,AlexandDoughtie,VI,"*DesignofMachineMembers*",McGrawHillCo.
- Spott,M.F.,"*MachineDesign*",PrenticeHallIndia.
- MaleevandHartman,"*MachineDesign*",CBSPublications.
- Black&Adams,"*MachineDesign*",McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Attheendofthecourse,astudentwillbeableto*

- **CO1:**DevelopttheProgramsinMatLABLanguageforthedesignofmachinecomponentswhichinclude Gears, Bearings andI.C. enginecomponents.
- **CO2:**ModelandsimulateGears,BearingsandI.C.Enginecomponentsusedinpowertransmissiona

pplicationswiththeirassemblyinaCADpackage.

- **CO3:**DesignandselectionofSpur,Helical,BevelandWormGears.
- **CO4:**Designofhydrodynamic,hydrostaticandrollingelementbearingsusedforpowertransmissionshafts.
- **CO5:**Designcylinder,piston,connecting-rodandcrankshaftsusedinICengines.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2,PO5/PSO1
CO2	PO2, PO5/PSO1
CO3	PO1, PO3/PSO1
CO4	PO1,PO3/PSO1
CO5	PO1,PO3/PSO1

BMEC0012:FLUIDMACHINERY

Pre-requisite:*FluidMechanics*

Objective:*Tounderstandbasicconceptof HydraulicTurbines,ReciprocatingPumpsandCentrifugal Pumpsandit'sapplicationtohydropowergeneration.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Classification of Fluid Machines & Devices, Application ofMomentumandMomentum,EquationtoFlowThroughHydraulicMachinery,Euler'sFundamentalEquation. **Impact of Jet:** Introduction to Hydrodynamic Thrust of Jet on A Fixedand Moving Surface (Flat *&* *C*urve), Effect of Inclination of Jet With theSurface. **HydraulicTurbines:**ClassificationofTurbines,ImpulseTurbines,ConstructionalDetails,VelocityTriangles,PowerandEfficiencyCalculations. **ReactionTurbines:**FrancisandKaplanTurbines,ConstructionalDetails, Velocity Triangles, Power and Efficiency Calculations, Degree ofReaction, Draft Tube, Cavitations in Turbines, Principles of Similarity,UnitandSpecific Speed, Performance Characteristics, Selection of Water Turbines, Governing ofTurbines.	20
II	**CentrifugalPumps:**ClassificationsofCentrifugalPumps,VectorDiagram, WorkDonebyImpellor,EfficienciesofCentrifugalPumps,SpecificSpeed,ModelTesting,Cavitations&SeparationandTheirControl,PerformanceCharacteristics. **Positive Displacement Pumps:** Reciprocating Pump Theory, Slip andCoefficient of Discharges, Indicator Diagram, Effect and Acceleration,WorkSavedbyFittingAirVessels,ComparisonofCentrifugalandReciprocatingPumps,PositiveRotaryPumps,GearPumpandVanePump, PerformanceCharacteristics. **HydraulicSystem:**HydraulicAccumulator,SpecialDutyPumps,Intensifier,HydraulicPress,LiftandCranes,TheoryofHydraulicCoupling and Torque Converters, Hydraulic Ram, Jet Pumps, Air LiftPumps.	20

TextBooks:

- Lal,Jagdish,"*HydraulicMachines*",MetropolitanBookCo.Pvt.Ltd.,2016
- Rajput, RK, "*HydraulicMachines*", S.Chand&coLtd.,2016
- Kumar,D.S.,"*HydraulicMachines*",KhannaPublishers,2010

ReferenceBooks:

- Vasandhani,V.P.,"*HydraulicMachines:Theory&Design*",KhannaPublishers,2019
- Addison,Thomas,"*AppliedHydraulics*",CBSPublishers,2003
- Philip, Gerhart and Wright Terry, "Fluid Machinery- application Selection and Design", CRSPublishers,2009

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Onlearningthissubject studentswillbeableto:*

- *CO1:Analyzetheforcesexerted byajetoffluid onfixed and movingvanes.*
- *CO2:Evaluatetheperformanceofmiscellaneoushydraulic machineshydraulicRam,press,intensifier*
- *CO3:AnalyzetheconstructionfeaturesandworkingprinciplesofPeltonTurbine,FrancisTurbineandKaplanTurbine.*
- *CO4:AnalyzetheconstructionfeaturesandworkingprinciplesofCentrifugaland Reciprocatingpump.*
- *CO5:Estimationofhydropowerpotentialandefficiencyof FrancisTurbineandKaplanTurbine.*
- *CO6:AnalyzetheperformancecharacteristiccurvesofFrancisTurbineandKaplanTurbine.*
- *CO7:Designandanalysisofdraft tubesusedinreactionturbines.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	PO's/PSO's
CO1	PO1,PO2,PO3/PSO1
CO2	PO1,PO2,PO6/PSO1
CO3	PO1,PO2,PO3/PSO1
CO4	PO1,PO2,PO12/PSO1
CO5	PO1,PO2,PO3/PSO1
CO6	PO1,PO2,PO3/PSO1
CO7	PO1,PO2,PO3/PSO1

BMEC0808FLUIDMACHINERYLAB

Objective: *Tounderstandbasicconceptof HydraulicTurbines,ReciprocatingPumpsandCentrifugal Pumpsanditsapplicationtohydropowergeneration.*

Credits:01 **SemesterVI** **L–T –P:0–0–2**

Module No.	Content	Teaching Hours
1	**ListofExperiments:** • DemonstrationofWorkingPrincipleoftheRunnerofPeltonWheel,Francis TurbineandKaplanTurbine. • ToFindEfficiencyandPerformanceCharacteristicsCurveofPelton Turbine. • ToFindEfficiencyandPerformanceCharacteristicsCurveofFrancis Turbine. • ToFindEfficiencyandPerformanceCharacteristicsCurveofKaplan Turbine. • ToFindthePerformanceCharacteristicsofACentrifugalPumpand ToFindItsSpecificSpeedandEfficiency. • ToFindthePerformanceCharacteristicsofAReciprocatingPump andtoFindtheSlip. • ToVerifyMomentumEquationExperimentallyThroughImpactofJetExperiment. • ToDeterminetheEfficiency ofHydraulicRam. • DemonstrationofAnyWaterPumpingStation/PlantThroughDetailedVisit. • DemonstrationofWorkingModelofHydraulicLift. • DemonstrationofWorkingModelofHydraulicBrake. • ToDesigntheImpellerofCentrifugalPumpUsingSingleArcMethodThroughAutoCad. • ToDesigntheCasingofImpeller PumpThroughAutoCad. • ToInvestigatethePerformanceofAGearPumpand toPlottheCharacteristics.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Onlearningthissubject studentswillbeableto:*

- *CO1:Selectahydroturbine(Peltonwheel, Francisturbine,Kaplanturbine)orapumponthebasicofavailableheadanddischarge.*
- *CO2: Determinetheforceexerted byajetoffluidonfixedand movingvanes*
- *CO3:Calculatevariousparameterslikeworkdone,efficiency,workingproportions,specificspeedofvariousturbines.*
- *CO4:Gainknowledgeaboutthedesignmethodologiesofvariouscomponentsofhydroturbineandpumps.*
- *CO5:Conductexperimentsforagivenpurposeandtoanalyzeexperimentaldataanddevelopempiricalequations.*
- *CO6:Understandtheworkingofhydraulicram,hydraulicbrake,torqueconverterandhydrauliclift.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO 1	PO1,PO2/PSO1
CO 2	PO1,PO2/PSO1
CO 3	PO1,PO2,PO3/PSO1
CO 4	PO1,PO2,PO12/PSO1
CO 5	PO1,PO2,PO12/PSO1
CO 6	PO1,PO2/PSO1

BMEC0013MANUFACTURINGSCIENCE –II

Pre-requisite: *ManufacturingScienceI*

Objective: *In this course students acquire the ability to formulate problems in Traditional and advanced metalcuttingandevaluatethecuttingparameters,establishacompletesolutiontometalcuttingproblemsusingmathematica lor graphicaltechniques.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Machining:** Mechanics of Metal Cutting. Geometry of Tool and Nomenclature, ASASystem, Mechanics of Chip Formation, Types of Chips. Merchant's Circle Analysis,CuttingForces,PowerRequired,ToolMaterial,ToolWearandToolLife,Machinability,Economicsofmetalcutting. **Grinding:**GrindingWheel,Abrasive&Bonds,GrindingWheelSpecifications,Grinding Wheel Wear, Attritions Wear & Fracture Wear, Dressing & Truing, SurfaceGrinding,Cylindrical Grinding&CenterlessGrinding **Machine Tools:** Working Principle, Constructions and Operations of Turret andCapstan Lathe, Tool LayOutTurretandCapstan Lathe, Shaper, Planer, Slotter,Milling,Dividing HeadandIndexing,Analysisofmaximumchipthickness,	22
II	**Additive manufacturing:**Introduction to Rapid Prototyping Technology (RPT),Rapid Manufacturing, Rapid Tooling Application and Advancement. Introduction ofSolid Based(SB),LiquidBased(LB),PowderBased(PB) RapidPrototyping. **AdvancedMachining:**WorkingPrinciple&ApplicationsofLaserBeamMachining (LBM),Electron Beam Machining (EBM), Electro chemical Machining(ECM),ElectricDischargeMachining(EDM),abrasiveJetMachining(AJM),UltrasonicMachining(USM)andPlasmaArcMachining(PAM)IntroductionofHybridMachining. **Super-Finishing Process**: Honing, Lapping & Buffing, Magnetic AbrasiveFinishing(MAF)	18

TextBook

- P.C.Sharma,"*ManufacturingTechnology(ManufacturingProcesses)*",S.ChandPublication,2006
- JainV.K.,"*AdvanceMachiningProcess*",PrenticeHall,2007.
- PPandey,HShan"ModernMachiningProcesses" McGrawHillEducation;Newedition2017
- GhoshandMalik,"*Manufacturingscience*",EastWestPvt.Ltd,2010.

ReferenceBooks:

- Boothroyd,"*FundamentalofMetalCuttingandMachineTools*",S.Chand,2017.
- JeffreyA.Hoffer"ModernMaterialsandManufacturingProcesses"PearsonEducation2007.
- SeropeKalpakjian,"ManufacturingEngineeringandTechnology(SIEdition)",2018
- P.N.Rao,"ManufacturingTechnology",Volume2|4thEMcGrawHillEducation;Forthedition,2018.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:Understand**andcomparethefunctionsandapplicationsofmetalcuttingtools,cuttingmotionsandconceptofgeneratrixanddirectrix.

- **CO2:Calculate**cuttingforces(PzandPx orPy)in straightturning atdifferentfeeds,velocitiesanddepthofcutandable toconstructMerchant'scircle diagram.
- **CO3:Recognize**chipformationmechanismandrelevantmatters(type,color&thickness)inturningmildsteelandevaluatetheroleofvariationofcuttingvelocityandfeedonchipreductioncoefficient /cuttingratioandshearangle
- **CO4:Understand**theworkingprincipleofshapingmachine,millingmachine,Capstanlathe,Turretlatheandslotter machine
- **CO5:A**pplythedifferentmetalremoving,finishingandsuperfinishingtechniquesforcomponentproduction,understandtheconceptofrapid prototypingandrapidtooling
- **CO6:Learn**thebasicconceptsapplication ofnontraditionalmachiningprocesses

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO4/PSO3
CO2	PO1,PO2,PO3/PSO3
CO3	PO1,PO3/PSO3
CO4	PO1,PO5/PSO2,PSO3
CO5	PO1/PSO3
CO6	PO1/PSO3

BMEC0809:MANUFACTURINGSCIENCE-IILAB

Objective:*The purpose of this lab is to enable the students to have the practical skills manufacturing operationsand design Jig and Fixtures, Cutting Tools, Measuring Tools, Press Tools for washer making, design of a circularform tool, design the gang milling arrangement of cutters , tooth profile & tolerances for arbor, cutter & key ,twist drill to machine the holes The student will also have practical exposure to analysis the cutting forcecomponentsofatoolpointwithdesignofvarioustoolanglesand machiningvariables.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	• DesignAProcessSheetShowingMachineTool,ToolLayout,OperationElements ,Jig&FixturesUsed,CuttingTool,MeasuringTool,CuttingConditionsfortheGive nComponentsasShownintheFigure. • ToDesignALayoutofFoundryShoptoProduce/ManufactureGivenComponent s. • Design A Drilling Jig for Drilling Four Holes on the Component as Shown intheFigure. • DesignASuitableMillingFixturefortheComponentShownintheFigure. • DesignAnIndexingJig/FixturefortheComponentShownintheFigure. • Design&DrawAPressTooltoProducetheComponentShownintheFigure. • Design & Draw A Press Tool Set to Produce A Washer at Each Stroke of thePress. The Washer is Made of Mild Steel 2 Mm Thick and 20 Mm is OutsideDiameter, Hole 8 Mm in Diameter. Assume Suitable Value of Shear StrengthofMaterial. • Design A Twist Drill to Machine A Hole in Cast Iron Gear Housing. The Holeis 20 Mm in Diameterby20 mm Deep and is Athrough Hole and theMachineToolisAVertical DrillPress. • Design the Gang Milling Arrangement of Cutters That You Would Providefor Machining of Faces Mark in Figure material of the Component is theCast Iron. Clearly Dimension Tooth Profile & Tolerances for Arbor, Cutter &Key. • DesignACircularFormToolfortheComponentShownintheFigure.AssumeSuit ableDataWhereverNecessary&AlsoFindtheToothProfile. • The Cutting Force Components of a Tool Point While Machining on MildSteelwitha10^{0}Back RakeAngle HighSpeedSteelToolis 105Kg. IfFeedis 0.06 Mm/Rev., Depth of Cut 2.2 Mm, Design a Suitable Cross Section of theTool, Assuming the Shear Strength of the Tool Material to Be 20 Kg. /Mm^{2}and A Factor of Safety is Approximately 2.5. The Young Module of the ToolMaterial is 20x10^3 Kg. /Mm^2. If the Maximum Permissible Deflection is 0.04Mm, Find the Extent by Which the Tool Can Be Projected Out of the ToolPost. RecommendSuitableValuesofToolAngles.Give ANeat Sketchofthe DesignedTool.	

TextBook

- P. C. Sharma, “*Manufacturing Technology (Manufacturing Processes)*”, S. Chand Publication,2006
- P Pandey,HShan“ModernMachiningProcesses”McGrawHillEducation;Newedition2017
- GhoshandMalik,“*Manufacturingscience*”,EastWestPvt.Ltd,2010.

ReferenceBooks:

- Boothroyd,“*FundamentalofMetalCutting and MachineTools*”, S. Chand,2017.
- SeropeKalpakjian,“ManufacturingEngineeringandTechnology(SIEdition)”,2018
- P.N.Rao,“ManufacturingTechnology”,Volume2|4thEMcGrawHillEducation;Forthedition,2018 .
- Rajender Singh, “Introduction to Basic Manufacturing Process & Workshop Technology”, NewAgeInternational;Secondedition, 2010.

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:Understand**ofdesignofvariousmachinetools,cuttingtools&measuringtoollayoutandconsiderationofmachiningvariablesat differentcuttingconditions.
- **CO2:Demonstrate**practicalskillsinthedesigningofpresstoolalongwithdieassemblyandtheoperationsperformedonthem.
- **CO3:Calculate**andoptimizethecuttingforcescomponentsofatoolpointbycuttingtool dynamometer.
- **CO4:Plan**andproducejobonshapingmachine,jobonmillingmachine,jobonplanerandslottermachine
- **CO5:Develop**amachiningprogramand processingofelectricdischargemachining.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/ PSO3
CO2	PO1/PSO3
CO3	PO1/ PSO3
CO4	PO1/PSO3
CO5	PO1/PSO3

BMEC0014:MODERNVEHICLETECHNOLOGY

Objective: *The course content should be taught and curriculum should be implemented with the aim to developdifferent typesofskillsleadingtotheachievementofthefollowingcompetency:*

- ***Improveefficiency,security,safety&performanceofautomobileusingelectronicsandtechnology.***

Credits:04 **SemesterIII** **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Applications of Transducers & Sensors:** Concept of general measurement system&differencebetweenMechanicalandelectrical/electronicinstruments;MeasurementofTemperature:WorkingofThermocoupleandThermister;Measurement of Speed: Contact less electrical tachometer, Inductive, Capacitivetype tachometer, Stroboscope; Measurement of Force: Strain gauge load cell; BasicrequirementofSensors,Functions,ApplicationsandCircuitryarrangementofvariousSensorssuchasMassAirflowratesensor,ExhaustgasOxygenconcentration, Throttle plate angular position, Crankshaft angular position, Coolanttemperature, Intake air temperature, Manifold absolute pressure (MAP), VehiclespeedSensor, RainSensor&Rainsensing wiper. **AdvanceIgnitionsystem:**Electrical & electronics ignition system.ModernSpark Ignition system (e.g. D.T.S.I , T.D.S.I., Multi electrode etc. System)Insulatedcoils.ConceptofNon-batteryEnergyStorage:Ultra capacitorsandFlywheels. **AdvancementinEngineandrelatedcomponents:**Introduction&typesofhybrid vehicle. Hybrid drives systems. Compressed air car.Solar Cars. Hydrogenoperated Engine. Basicconcepts of Blue MotionTechnologies like DSG, TSI, TDI,GDI variablevalvetiming system.	28
II	**Modernization in Peripheral systems:** Security Systems. Remote keyless entry,Anti-theft system, Alarm system. Entertainment and peripheral systems. Integratedcommunications, Proximitysensors, Globalpositioning satellites(GPS). **Advance Safety Equipments:** Seat Belts, Seat Belts pre-tensioners, Smart seatbeltReminder,ConceptsofCrashtest,Crashsensors.AirbagsIntroductionofairbags, Duelstageairbags,SideAirbags.TirepressuremonitoringsystemPedestrianProtection& Nightvisionwithpedestriandetection. **Modern Features in Automobile:** Power Sliding doors. Electronic stability / Skid-control system, Traction control system. Telescopic steering wheel / adjustablepedals.RearmountedRadar&Cameras.Electromagneticsuspensionandlevitation. Automatic Lift Axle. Regenerative Braking Systems. Continuous VariableTransmission. IntelligentParking AssistSystem,Self Parking.	21

TextBooks:

- TomDenton,‘AutomobileElectricalandelectronicsystems’,ArnoldISBN-0750662190,thirdedition,2004.
- TharejaBL,‘FundamentalsofElectricalandElectronicsEngineering’,NirjaConstruction&DevelopmentCoLtd,NewDelhi,1984.
- PLKohli,‘AutomotiveElectricalEquipments’,TataMc-Graw Hill,NewDelhi,1983.
- A.K.SawhneyandPuneetSawhney,‘ACourseinElectricalandElectronicMeasurementsandInstrumentation’, DhanpatRai andsons,NewDelhi, 1973.

ReferenceBooks:

- JohnTurner,'AutomotiveSensors',Momentumpress,LLCNEWYORKISBN-9781606500095,ISBN-1606500090, 2009.
- Barbara J. Peters, George A. Peters, 'Automotive Vehicle Safety', SAE International and Taylor & FrancisISBN -978-0-7680-1096-1,London,2002.
- J. Marek, H.-P. Trah Sensors, 'Automotive Technology', Y.Suzuki, I. Yokomor / ISBN – 3527295534Wiley-vch,weinheim, 2003.
- JeffDaniels, 'ModernCarTechnology', JHaynes&Co. Ltd.,2009

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome:Attheendofthecourse,astudentwillbeableto

*CO1.Describeconstruction,functionsandapplicationsofvarioussensorsandactuatorsusedinmodernvehicle.**(Understand)***

CO2.*Explainmodern IgnitionsystemsofS.I.andC.I.Engines.**(Understand)***

*CO3DescribelatestadvancementinEnginetechnology.**(Understand)***

*CO4 Identifyand describevariousadvanced peripheralsystemusedinautomobile.**(Analyze)***

*CO5Demonstratevarioussafetyfeaturesand equipment usedinmodernvehicle.**(Apply)***

*CO6DescribevariousmodernfeatureslikeEBD,ABS,RegenerativeBrakingSystemetcforbetterfunctioningofvehicle.**(Understand)***

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO6,PO12/ PSO1
CO2	PO1,PO3,PO4,PO6,PO10/PSO1
CO3	PO2,PO3,PO4,PO6/ PSO1
CO4	PO2,PO3,PO4,PO6/ PSO1
CO5	PO3,PO6,PO9/PSO1
CO6	PO1,PO3,PO6,PO9/ PSO1

BMEC0015ADVANCEMATERIALSCIENCE

Objective: *Materials Science is focused on the fundamentals of biomaterials, nanomaterials, ceramics,metals,polymers,electronicmaterialsandcomposites,smartmaterials,greenandsustainablematerials emphasizing the relationships between atomic structure and microstructure as well as theproperties,processingandperformanceofthematerialinacohesiveandself-containedwaywithinthecourse.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**CrystallographyandImperfections:**ConceptofUnitCellSpaceLattice,Bravais-Lattices,AtomicPackingFactorandDensitycalculations,Millerindices,Imperfections,DislocationsTheory,Diffusioninsolids,Mechanicalproperties,elasticandvisco-elasticproperties **Fatigue**:Stresscycles,Factorsaffectingfatigue,crackpropagation, **Creep:**Creepcurve,stages increepcurve Stressrelaxation,DuctileandBrittlefracture,Griffiththeory,Seasoncracking **StrengtheningMechanism:**ConceptofGrainandGrainBoundary,Hall-Petchstrengthening,Solidsolutionstrengthening,precipitationstrengthening,dispersionstrengthening. **Equilibrium Diagrams:** Types of Equilibrium-Diagrams: Solid-SolutionType, Eutectic Type and Combination Type. Iron-Carbon Equilibrium-Diagram andItsImportance.	21
II	**Heat Treatment:** Various Types of Heat Treatment Such As Annealing,Normalizing,Quenching,TemperingandCaseHardening.TimeTemperatureTransformation(TTT)Diagrams. **Corrosion Science:** Definition and importance, Electrochemical reactions,Polarization,Passivity,Environmentaleffects,Eightformsofcorrosion,Cathodicprotection,Coatingsandinhibitors. High temperature materials and Materials for cryogenic applicationConcept of Magnetism and Magnetic materials, Superconductors and itstypes and phenomenon of Superconductivity, Metallic foams, Ceramics,Polymers,Composites,Carbonfibre,Graphene,NanoMaterials,Smart Materials.	23

TextBooks:

- GuptaK.M.,"*MaterialsScience*",UmeshPublication.
- RaghvanV.,"*MaterialScience*",PrenticeHall.
- Narula,"*MaterialScience*",TMH.

- Fontana,M.G.,“*CorrosionEngineering”*,TataMcGraw-Hill.

ReferenceBooks:

- CallisterW.D., JR,“*MaterialScience&Engineering*”,Addition-WesleyPublication.
- VlackVan,“*ElementsofMaterialScience&Engineering*”,JohnWiley&Sons.
- Avner“IntroductiontoPhysicalMetallurgy”TMHPub

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:**Understandthelimitsofmaterialsandthechange oftheirpropertieswithuse.
- **CO2:**Createanewmaterial that willhavesomedesirableproperties.
- **CO3:**Prepareadvancedcomposite materialsforspaceandmissileapplication.
- **CO4:**Optimalselectionofengineeringmaterialsthatmustsimultaneouslyfulfilldimensional,property, qualitycontrolaspects.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3

BMEE0201COMPUTERAIDEDDESIGN

Pre-requisite: *Machine Design II*

Objective:

- *To understand the use of Information technology in the Design Process.*
- *To understand the automation of design process.*
- *To understand the integration of CAD/CAM system.*
- *To understand the concept of numerical technique in automation of design.*

Credits:03 **L–T–P:3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:**Introductionto Design,Elements/RequirementsofCAD,IntroductiontoCAEandCIMS,Necessity&ItsImportance,EngineeringApplicationsof CAD **ComputerGraphics-I** CADSystems,GraphicsInputDevices,OutputDevices,GraphicsDisplay Devices-CRT, LCD, LED, Touch panel display, Plasma Display,Virtual Display. Graphicsdisplaytechnique:- Random & Raster ScanDisplayGraphicsStandards,Animationandmultimedia,GraphicsFunctions,RasterizationofOutputPrimitives:LineDrawingAlgorithm,CircleGeneratingAlgorithm, **ComputerGraphics–II:-** Coordinate Representation, Windowing and Clipping, Object modeling.Geometric Transformations (2D/3D) - Translation, Scaling, Shearing,Rotation&ReflectionMatrixRepresentationandconcatenation. Candidatemustbesubmitonemini-projectbasedonComputergraphics-I andII. **Geometricmodelingofcurve:** PropertiesofCurveDesignandRepresentation,InterpolationVsApproximation.Parametricandnon-parametricrepresentationofCurves. Importance of Convex Hull. Parametric Continuity Conditions.Geometricmodelingofcurve:-HermiteCubicsplines,BezierCurves,BezierCurves.IntroductiontoNubCurve.IntroductiontoSurfacerepresentation.	20

II	**SolidModelling:-** Surfacefitting:Beziersurfacepatchmodel,B-splinesurfacepatchmodel,QuadricandSuper-quadricSurfaces. SolidModellingapproaches:-PolygonMeshRepresentations,BoundaryRepresentation,ConstructiveSolidGeometry,BlobbyObjects,Sweeping, Loftingandothermodelingmethods **Animationsystem:-** Animationsystem,animationtechnique,Softwareusedtoperformanimation. **Application of Numerical method in Automation of design:**Application,algorithmandprogramoffollowingnumericaltechnique:Rootfindingmethod:-N-Rmethods,Bi-sectionmethod. Interpolation:Newtonforwardandbackwardinterpolation,Lagrangeinterpolation.NumericaldifferentiationusingNewtonforwardand backwardformula.NumericalIntegration.	20
	IntroductiontoFiniteelementanalysis: IntroductionClassificationofDifferentialEquations,VariationalFormulationApproach,RitzMethod,GeneralizedDefinitionofAnElement, Element Equations From Variations, Introduction, Principlesof Finite Elements Modeling,Stiffness Matrix/Displacement Matrix.Stiffness Matrix for Spring System, Bar & Beam Elements,Bar Elementsin2DSpace (TrussElement) **ApplicationSoftware**:ApplicationCommandsforDraftingsoftware	

TextBooks:

- *I.Zeid,"CAD/CAM:TheoryandPractices":TataMcGraw-Hill.*
- *R.KSrivastava,"ComputerAidedDesign":UmeshPublication.*

ReferenceBooks:

- *P.NRao,"CAD/CAM:Principlesandapplications":TataMcGraw-Hill.*
- *R.BPatil:"Computeraideddesign":Tech-MaxPublication.*
- *J.NReddy,"Introductiontofiniteelementmethods":TataMcGraw-Hill.*
- *B.s.Grewal,"NumericalMethod":KhannaPublishers,2010.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: **Aftercompletionofthecourse,studentwillbeableto:**

CO1: Understand that the computer is not only a tool of visualization but also a tool forautomationofdesign.
CO2:Collaboratewithpeopleofdiversebackgroundsandabilities.
CO3:Identifythefactorsinthecomputeraidedprocessandproductdevelopment.CO4: Create the different wireframe primitives using parametric representations.CO5:Knowcomputeraideddesignconceptisnotlimitedto computerprograms.
CO6:Evaluatecomputeraideddesignmodelsandassembliesbasedoncriticalthinkingandproblemsolving skills.

CO7:Communicateandpresentideasandsolutionstodesign problems.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO6,PO10/PSO3
CO2	PO1,PO12/ PSO3
CO3	PO2,PO4,PO11/,PSO3
CO4	PO5,PO6,PO9,PO11/PSO3
CO5	PO3,PO4,PO10,PO12/PSO3
CO6	PO3,PO5,PO7,PO8,PO12/PSO3
CO7	PO8,PO9,PO11,PO12/PSO3

BMEE0202CONTINUUM MECHANICS

Pre-requisite:*Strength of Materials*
Objective:*The aim of the continuum mechanics is to deals with the analysis of the kinematicsand the mechanicalbehaviorofmaterialsmodeledasacontinuous mass rather thanasdiscrete particles.*

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	Cartesiantensors.Thelinearelasticboundaryvalueproblem.Boundaryconditions.Naviersequations.Planewaves.Generalconservation laws for mass, momentum and angular momentum.**Deformationofacontinuum:**EulerandLagrangedescriptions,displacement vector, strain tensor, principal strains, compatibilityequations.	20
II	**The state of stress in a continuum:** stress vector, stress tensor,principalstress, equations ofmotion. **Constitutive equations:** isotropic and anisotropic linear elasticmaterials.Newtonianfluids:compressibleandincompressible fluids,Navier-Stokes equations.	20

TextBooks:

- P.Chadwick,"ContinuumMechanics:ConciseTheoryandProblems": Dover Publications,2012.
- J.W.Rudnicki, "Fundamentalsof ContinuumMechanics":WileyPublications,2014.

ReferenceBooks:

- Y.C.fung,"AFirstCourseinContinuumMechanics": Pearsonpublication,1993.
- W. M. Lai and D. H. Rubin, "Introduction to Continuum Mechanics": Butterworth-HeinemannPublication,2009.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Attheendofthecoursethestudentwillbeableto:*

- **CO1:**Applythetensorformalism,
- **CO2:**Analyzegeneralstressesanddeformationsincontinuousmaterials.
- **CO3:** Formulateandsolvespecifictechnicalproblemsofdisplacement,strainandstress.
- **CO4:** Numerically model and analyze the stresses and deformations of simple geometries under anarbitraryloadinbothsolidsand liquids.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3
CO2	PO2,PO3/PSO3
CO3	PO1,PO3/PSO3
CO4	PO1,PO3,PO4/PSO3

BMEE0203 FINITE ELEMENT METHODS

Pre-requisite:*Continuum Mechanics*

Course objective: *The objective of this course is to teach in a unified manner the fundamentalsofthefiniteelementmethodfortheanalysisofengineeringproblemsarisinginsolids ,structuresandsomebasicthermalengineering.Thecoursewillemphasizethesolutionofreal life problems using the finite element method underscoring the importance of the choiceof the proper mathematical model, discretization techniques and element selection criteria.Finally, students will learn how to judge the quality of the numerical solution and improveaccuracyinanefficientmannerbyoptimalselectionofsolution variables.*

Credits:04 **L–T–P:3-1-0**

Module No.	Contents	Teaching Hours
1	**Introduction:** Finiteelementmethodasanumericaltoolfordesign,Basicconcepts,Formulationprocedures,Historical development. **LineElementsandApplications:** Structural Problems: Linear and Quadratic elements, 1D Bar element,FormulationofTrusselement,Planetruss,Euler–Bernoullibeamelementformulation. ThermalandFluidProblems:Steadystateheattransfer:Elementformulations, treatment to boundary conditions with application to 1-Dheatconduction,heattransferthroughthinfins;Potentialflowproblems **2D Elements**: Triangular (CST, LST): Shape function, Jacobian matrix,strain-displacementmatrix,stress-strainrelationshipmatrix,forcevector. QuadrilateralElements(Q4,Q8):Shapefunction,Jacobianmatrix, strain-displacementmatrix,stress-strainrelationshipmatrix,forcevector.	20
2	**Application to Field Problems**: Thermal problems, Torsion of Noncircular shafts, Plane stress, plane strain and axisymmetric problems – Bodyforcesandtemperatureeffects,Stresscalculations,Plateandshellelements **DynamicProblems:**Formulationofdynamicproblems,consistentandlumped massmatrices for1-D and2-Delement, Solutionofeigenvalue1-Dproblems-Longitudinalandtransversevibrationofbeamswithallpossibleboundary conditions:Transformationmethods,Jacobimethod,VectorIterationmethods, subspaceiterationmethod.Solutionto1DtransientHeattransferproblems.	20

TextBooks

- T. R. Chandrupatla, Finite Element Analysis for Engineering and Technology, UniversityPress,2018

- P.Seshu,TextBookofFiniteElementAnalysis,PHILearningPvt.Ltd.,2012
- J. N. Reddy, An Introduction to the Finite Element Method, McGraw Hill InternationalEdition,2005

ReferenceBooks

- S.S.Rao,TheFiniteElementMethodinEngineering,ButterworthHeinemann,2017
- K.J.Bathe,FiniteElementProceduresinEngineeringAnalysis,PrenticeHallofIndia,2007
- O.C.Zienkiewics,R.L.Taylor,TheFiniteElementMethod,VolI&II,McGrawHill,1967

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome:

- *CO1:Understandthebasictheoryoffinite-elementmethod.*
- CO2:*Tounderstandtheuseofthebasicfiniteelementsforstructuralapplicationsusingtruss,beam,frame,and...*
- CO3:*Understandtheroleandsignificanceofshapefunctionsinfiniteelementformulationsanduselinear,quadratic, andcubicshapefunctionsfor interpolation.*
- CO4:*Understandtheformulationofone-dimensional,twodimensionalandthreedimensionalelements.*
- CO5:*RecognizesourcesoferrorsinFEA.*
- CO6:*todeveloptheabilitytogeneratethegoverningFEequationsforsystemsgovernedbypartialdifferential equations*

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO1,PO2/PSO1
CO4	PO1/PSO1
CO5	PO5/PSO1
CO6	PO2,PO3/PSO1

BMEE0204 VIBRATION & NOISE

Pre-requisite:*DynamicsofMachine*

Course objective:*The objective of this course is to have a clear understanding of vibrationsandmodellingofmechanicalsystems.Studentswillanalysefreeandforcedvibrationsand willdevelop mathematicaltechniquestomodelanddesignmechanical systems.*

Credits:04 **L–T–P:3-1-0**

Module No.	Contents	Teaching Hours
I	**Introduction:**FreeandForcedVibrationsofSingleDegreeofFreedomSystem, Newton's Second Law, D'Alembert's Principle, Lagrange'sEquation, Types of Damping, Algorithmic Decrement, Equivalent ViscousDamping,Support Excitation. **Basic Vibration Control:** reduction at source, Active feedback control,VibrationIsolationandTransmissibility. Two Degree of Freedom Systems: Free and Forced Vibrations With andWithoutDamping,PrincipleandNormalModes,VibrationAbsorbers. **Multi Degree of Freedom Systems:** Various Methods of Analysis of MultiDegreeFreedomSystems,InfluenceCoefficients,CouplingofModes,Rayleigh'sMethod, Dunkerley'sEquation,Holzer'sMethod	22
II	**VibrationofContinuousSystems:**WaveEquation,LongitudinalVibrationof Bars, LateralVibrationsof Beam. **PassiveVibrationControl:**Basics,designofabsorber,absorberwithidealspring,shockabsorber,isolators withstiffnessanddamping. **ActiveVibrationControl:**Basics,Piezoelectricmaterials,electrorheologicalfluids,magnetorheologicalfluids,Magneto- andElectrostrictiveMaterialsinVibrationControl. **VibrationMeasurement:**Basics,dataacquisition,IntroductiontoCondition Monitoringof Machinery,FFTanalysisandfilters	20

TextBooks

- G.K.Grover,"MechanicalVibrations": NemChandandBros,2009.
- S.S.Rao,"MechanicalVibrations",AddisonWesleyPublishingCompany,1990.
- S.G.Kelly,"MechanicalVibrations,Schaum'sOutlines",TataMcGrawHill, 2008.

ReferenceBooks

- J.S.rao,"VibrationConditionMonitoringofMachines":TataMc-GrawHill,2006.
- D.J.Inman,"VibrationandControl":JohnWilley&SonsInc,2002.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Afterstudyingthissubjectstudentswillbeableto:*

- **CO1:**Analyzethemathematicalmodelingofthetwodegreesoffreedomsystemsandexplainabout theworkingprincipleof vibration absorber.
- **CO2:**Computethenaturalfrequenciesandmodeshapesofamultidegreeoffreedomsystemandex plainthemodalanalysisof a vibratingsystem.
- **CO3:**AbilitytouseLagrange'sequationsforlinearandnonlinearvibratorysystems.
- **CO4:**Understoodtheparametersandvariablesofavibratingsystem.
- **CO5:**Understoodtheconceptofnaturalfrequencyandhowtofinditforavibratingsystem.
- **CO6:**Learntheprocessofvibrationmeasurementsandcontrol.

MappingofCourseOutcomes(COs)withProgram outcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO3
CO2	PO1,PO2/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO2/PSO3
CO5	PO1,PO3/PSO3
CO6	PO1/PSO3

BMEE0301COMPUTERAIDEDMANUFACTURING

Pre-requisite:*ManufacturingScienceII*

Objective:*Acquire fundamentalunderstandingoftheprinciplesofCAM,includingCNCprogramming,conceptofCIM&Robotics.*

Credits:03 **L–T–P:3–0–0**

ModuleNo.	Contents	Teaching Hours
I	**Automation:** IntroductiontoCAM;AutomatedManufacturingSystem;Automation,NeedofAutomation,BasicElementsofAutomation,LevelsofAutomation,AutomationStrategies,Advantages&DisadvantagesofAutomation,HistoricalDevelopmentandFutureTrends. **NCSystem:** Fundamental of Numerical Control, Elements of NC Machine Tools, Classification of NC Machine Tools, Advantages, Suitability and Limitations of NC Machine Tools, ApplicationofNCSystem,MethodsforImprovingAccuracyConsideringtheFactorsSuchasToolDeflectionandChatterandProductivity.ToolingofNCMachines.ConfigurationofCNC,DNCandAdaptiveControl. **NCPartProgramming** (A) Manual (Word Address Format) Programming. Examples Drilling, Turning andMilling;CannedCycles,Subroutine,andMacro. (B) APTProgramming.Geometry,MotionandAdditionalStatements,Macro-Statement.	20
II	**SystemDevices:** Feed Back Devices, Counting Devices, Digital to Analog Converter and Vice Versa.Interpolatorslike Digital Differential IntegratorLinear, CircularComputerAidedInspection(CAI)andComputerAidedTesting(CAT). **ComputerIntegratedManufacturingSystem** Concept of ComputerIntegratedManufacturingSystem, Impact of CIM on personnel,Roleofmanufacturingengineers, CIMWheeltounderstandbasicfunctions. GroupTechnology,FlexibleManufacturingSystem,CAD/CAM,ComputerAidedProcessPlanning-Retrieval andGenerative,ConceptofMechatronics. **Robotics** Robot Anatomy, Laws of Robot, Human System and Robotics, Coordinate system,SpecificationsofRobot.Powersources,actuatorsandTransducers,RoboticSensors,Grippers,RobotSafety,RobotProgrammingandRobotApplications.	20

TextBooks:

- KundraandRao,“*ComputerAidedManufacturing*”,TMH,NewDelhi.
- Koren,“*ComputercontrolofManufacturingsystems*”,TMH,NewDelhi.
- Koren,“*NCMachines*”,TMH,NewDelhi.

ReferenceBooks:

- Groover Mikell P., "*Automation, Production Systems and Computer IntegratedManufacturing*",PrenticeHallPublishers.
- S.J.Martin,"*NCMachineTools*",TMH,NewDelhi.
- Groover,"*CAD/CAM*",PrenticeHallPublishers.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome:*Aftercompletionofthiscourse,theStudentswillbeableto:*

- CO1:Understandtheneedofautomationanditsstrategiesusedfordevelopmentinmanufacturing.(Understand)
- *CO2:DescribebasicconceptsofCAMapplicationandCIMwheel.(Remember)*
- *CO3:PrepareCNCprogramsformanufacturingofdifferentgeometriesonmillingandlathemachines.(Apply)*

- CO4:Understandtheconceptofgrouptechnology,CIM,FMSandCAPPsystemusedinindustries.(Re member)
- CO5:DescribetheuseoffeedbackdevicesusedinCNCmachines.(Remember)
- CO6:IllustratethebasicpartsandnecessityofRoboticsysteminIndustries.(Understand)

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	PO/PSO
CO1	PO3/PSO2
CO2	PO1,PO3/PSO2
CO3	PO1,PO6/PSO2
CO4	PO2/PSO2
CO5	PO1/PSO2
CO6	PO6/PSO2

BMEE 0402 PRODUCT DESIGN AND DEVELOPMENT

Objectives:

- *TostudythebasicconceptsofProductdesignandDevelopment.*
- *Tostudytheapplicabilityofproductdesignanddevelopmentinindustrialapplications.*
- *Tostudythekeyreasonsfordesignorredesign*.

Credits:03 L–T–P:3–0–0

Modul eNo.	Content s	TeachingHours (Approx.)
I	Classification/SpecificationsofProducts.Productlife cycle. Productmix,Introductiontoproductdesign,TheRoleandNatureofDesign,OldandNewDesignMethods,DesignbyEvolution.,DesignbyCraft,NeedBasedDevelopment,TechnologyBasedDevelopments,EconomicFeasibilityofDesign Concepts, Modern product development process,Innovativethinking, Morphologyof design. **Reliability:**ReliabilityConsiderations:ReliabilityAnalysisofSystems,BathTubCurve,ReliabilityofSystemsinSeriesand Parallel.FailureRate,MeanTimetoFailure(MTTF)andMeanTimeBetweenFailures (MTBF).	20
II	**DecisionTheory:**DecisionMakingUnderConditions of Certainty, Decision Making Under Conditions of Uncertainty,DecisionMakingUnderConditionsofRisk,MaximumLikelihoodCriterion,VariationofExpectedValueCriterion. **Break-Even Analysis**: Fixed and Variable Costs, Assumptions ofBreakEvenAnalysis,UtilityofBreakEvenAnalysis,Limitation ofBreakEvenAnalysis **Statistical Quality Control (SQC):** Advantages of StatisticalQualityControl,QualityControlCharts,TypesofControlChartsSuch as X(Bar)and R Chart,P Chart andC Chart. **Technological Forecasting**: Characteristics and Importance ofTechnologicalForecasting,DifferentForecastingMethods, **Patents&IPActs-**Overview, Disclosurepreparation.	20

TextBooks:

- ChitabA.K.&GuptaR.C.,"*ProductDesign&Manufacturing*",PHI(EEE).
- UlrichK.T,andEppingerS.D,"*ProductDesignandDevelopment*",TataMcGrawHill

ReferenceBooks:

- StarrM.K.,"*ProductDesign&Decision Theory*",PrenticeHall.
- CainC.D,"*EngineeringProductDesign*",BusinessBooks.
- MayallW.H.Itiffe,"*IndustrialDesignforEngineers*", TMH.
- J.ChristopherJones,"*DesignMethods–seedsofhumanfutures*",JohnWiley&Sons.

- JamesBoyle,JenniferJenkins,INTELLECTUALPROPERTY:LAW&THEINFORMATIONSOCIETY -CASES&MATERIALS,

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Students will be able to:

CO1.Identifyandanalyzetheproductdesignanddevelopmentprocessesinmanufacturingindustry.
CO2.Definethecomponentsandtheirfunctionsofproductdesignanddevelopmentprocessesandtheirrelationshipsfromconcepttocustomeroverwholeproductlifecycle.
CO3.Analyze,evaluateandapplythemethodologiesforproductdesign,developmentandmanagement.
CO4.Decisionmakingabilityofthestudentswillimprove,theycantaketherightdecisionsregardingtheproductwithouttheproperinformation.
CO5.Undertakeamethodicalapproachtothemanagementofproductdevelopmenttosatisfycustomerneeds.
CO6. Carryoutcostandbenefitanalysisthroughvariouscostmodels.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs / PSOs
CO1	PO1 / PSO1
CO2	PO2 / PSO1
CO3	PO3 / PSO1
CO4	PO3 / PSO2
CO5	PO11/ PSO2
CO6	PO11/ PSO2

BMEE0403OPERATIONSRESEARCH

Pre-requisite:*IndustrialEngineering*

Objective:

- *Providenknowledge of OPTIMIZATIONapproaches*
- *TodevelopDecision-makingskills.*
- *Providescopetostudentstoresearchmethodsandlatesttrendsinoperationresearch.*
- *Tounderstandthevariousbusinesssituations.*

Credits:03 **L–T–P:3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:**BasicsofOperationsResearch,ApplicationArea,Models,AdvantagesandDisadvantagesofOperationsResearch. **LinearModels:** **Linear programming:** Problem Formulation, Graphical Method, SimplexMethod, Duality in Linear Programming, Big M-Artificial Variable Method,Degeneracy. **AssignmentProblems:**MathematicalFormulation,HungarianMethodProblem, Degeneracyin Assignment Problem **Transportation:**Matrix Form, Basic Feasible Solution:- North west method,Leastcostmethod,Vogel'sapproximationmethod.OptimumSolution:-MODImethod,Unbalanced-Problems, **DynamicProgramming:**MultistageDecisionProblems&Solutions,Principle ofOptimality. **Game Theory:**Two Persons Zero Sum Game, Solution With/Without SaddlePoint,propertyofDominance,Graphical methods	20
II	**Sequencing:**Introduction,Assumption,Johnson'sProcedureforNJobsonTwo MachinesandNJobsonThreeMachines. **Simulations:** Simulation V/S Mathematical Modeling, Monte-CarloSimulation,SimulationLanguages,Uses,Advantagesand Limitations. **InventoryModels:**Variouscostandconcepts,EOQ,Deterministicinventorymodels-productionmodel-Buffer stock **QueuingModels**:Introduction,PoissonandExponentialDistribution,SingleServer andMultiServersModels. **Networks:**BasicConcepts,Constructionofnetworks,RulesforNetworkDrawing,CPMCalculations. Pert Calculations Such As Different Times and Different Floats.Casestudybased2 Miniprojects.	20

TextBooks:

- *GuptaPremKumar,HiraD.S.,"OperationsResearch":S.Chand&Co.*
- *Taha,HamdyA.,"OperationsResearch":PrenticeHallInternationalPublications.*

ReferenceBooks:

- *Wagner,Claire,"PrinciplesofOperationsResearch":PrenticeHallInternationalPublications.*
- *Buffa,Edwood,"ProductionPlanningofOperationManagement":TMHPublications.*
- *Rao,S.S.,"OptimizationTechniques":WileyEasternLimited.*
- *Pradeep.p.Pai,"OperationResearch":OxforduniversityPress.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

After completion of thecourse,studentwillbeableto:

- **CO1:ToimpartknowledgeinconceptsandtoolsofOperationsResearch.**
- **CO2:Applytheknowledge&toolsofoperationresearchinvariousindustries.**
- **CO3:Proficienttorecognizetheimportanceandvalueofmathematicalmodeling in solving practical problems in industry by linear programmingproblems.**
- **CO4: Understand the mathematical tools that are needed to formulate &solvetransportationproblemsforcost optimization.**
- **CO5: Understand the process of best strategy using decision making methodsunderuncertaintyandgametheory.**
- **CO6: Determine the optimum sequence of n job over 2 and 3 machining bysequencing.**
- **CO7:Understandtheconceptofprojectnetwork,projectscheduleandproject monitoring activitiesbyusingCPMandPERTmethod.**

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs)

COs	**POs/PSOs**
CO1	**PO1,PO2,PO6/PSO3**
CO2	**PO1,PO9/PSO3**
CO3	**PO2,PO11/PSO3**
CO4	**PO5,PO9,PO11/PSO3**
CO5	**PO3,PO4,PO10,PO12/PSO3**
CO6	**PO3,PO5/PSO3**
CO7	**PO8,PO11,PO12/PSO3**

BMEE0406APPLIEDERGONOMICS

Pre-requisite:*ProductDevelopment&Design*
Objective:*Theobjectiveofthiscourseistointroduceindustrialergonomicsandthevastapplicationofergonomics in industryanddesignresearchforproductsystem.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:**DefinitionofErgonomics/HumanFactors.TheevolutionofErgonomics, reasons to use ergonomics, micro- and macro- ergonomics, performingergonomics,judging the effectivenessofergonomicsintervention. **HumanBody:**Humancapabilitiesandlimitationsintermsofengineering.Anthropometrical, Physiological,Psycho-socialconsiderationsinErgonomics. **Ergonomicsdesignmethodology:**Occupationalsafetyandstressatworkplace;Workstation design; Furniture and Environment factors affecting human performance;Designdevelopmentandusability evaluation. **OfficeWorkstation**: Theories of healthy standing and sitting, free posturing, ergonomicsdesignoftheofficecomputerworkstation. **Methods, Standards and Work Design:** Determination of work content, workstation,workmethods,andtimesrequiredforvariousoccupationaljobs/tasks.Designoftasks/jobs, workplace, and work environment to increase productivity, eliminate waste,anddecreaseoccupational injury/illness.	22
II	**Musculo-skeletalsystem**:Jointmotionstudy,Basicmodeloncalculationofbiomechanicalstressesonourbody. **Product Ergonomics:** Product ergonomics and design, design from the view point ofbiomechanics,Workpostureanalysis,staticanddynamicwork,thevisual,auditoryandthermal environment and their impact on design. design for the physically challenged.**Research technique:** Ergonomic data generation, interpretation and application ofstatisticalmethods.Caseanalysis. **Miniproject:**MiniProjectworkinvolvingergonomicdesignresearchforproductsystem.	18

TextBooks:

- M.S.SandersandErnestJ.McCormick:Humanfactorsinengineeringanddesign,sixthEdi.McGraw-HillInternational Editions,1987.
- P.O. AstrandandK.Rodahl:Textbook of work physiology,McGrawHill,New York,1970.
- Konz SA & Johnson S. Work Design: Industrial Ergonomics. 6thEdition, Holcomb HathawayPublishers,2004.ISBN:1-890871-48-6

ReferenceBooks:

- R.SBridger, Introduction toErgonomics,McGraw-HillInc.,1995.
- G.SalvendyEd.,HandbookofHumanFactorsandErgonomics,JohnWileyandSons,1997.
- D.Chakrabarti,IndianAnthropometricDimensionsforErgonomicDesignPractice,NationalInstituteofDesign,Ahmedabad,1997.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Uponcompletionofthecourse,studentsshouldbeableto:*

- CO1: *Apply basic knowledge of physical ergonomics such as physical load, anthropometry, biologicalvariationandbiomechanics.*
- CO2:*Explainandapplybasicknowledgeofcognitiveergonomicssuchasperception,memory,informationprocessing,attention,learning,decision-making,stress,mentalworkloadandmaltreatment,*
- CO3: *Apply basic knowledge of physical factors affecting human beings in relation to light, lighting,sound andnoise,climateandvibrations.*
- CO4: *Identify and relate factors affecting human performance in the interaction with products, analyseand reflect on the results of ergonomic analysis of product systems and draw conclusions and giverecommendationsforproductimprovement.*
- CO5:*Presentacompletedergonomicanalysisofproductandworkplaceorallyandinwriting.*

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

Cos	POs/PSOs
CO1	PO3/PSO1
CO2	PO2/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1

BMEE0503ENGINEERINGSYSTEMMODELLINGANDSIMULATION

Pre-requisite:*IndustrialEngineering*

Objective:*Tointroducethestudentsabouttheknowledgeofbasicanddynamicsystemmodelsofengineeringandsimulation system.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**BasicSystemmodels:**Mathematicalmodels,Mechanicalsystembuildingblocks, Electrical system building block, fluid system building block, thermalsystembuildingblock. **SystemModels:**Engineeringsystems,Rotationaltranslationalsystems,Electro-mechanicalsystems, linearity,HydraulicMechanicalsystems. **DynamicResponseofSystems:** Modellingdynamicsystems,Terminology,Firstordersystems,secondordersystems, performance measure of second order systems, system identification.**System Transfer Functions:** The transfer function, first order systems, second order systems, systems inseries,systemswithfeedbackloops,effectofpolelocationontransientresponse.	19
II	**Mechanical Event Simulation (Finite Element modelling and Analysis):**Introduction,Generalprocedureoffiniteelementmethod,finiteelementanalysis,iso-parametricevaluationofelementmatrices,finiteelementmodelling,meshgeneration,designandengineeringapplications.IntroductiontoProEsoftware-Mechanica&dynamicsimulation module. **SystemSimulation:** Introduction, Review of probability and statistics, managing the event calendarinadiscreteeventsimulationmodel,modellinginputdata. Generation of random numbers and variates, generic features and introductionto Arena Software, Real world applications of simulation, discrete continuoussimulation,verificationandvalidationofsimulation models.	19

TextBook:

- W.Bolton,“Mechatronics–ElectroniccontrolsystemsinMechanical&ElectricalEngineering”,PearsonEducationLtd.1868
- IbrahimZeid,“CAD/CAMTheoryandPractice”,TataMcGraw-HillPublishingCompanyLimited.1991
- SankarSengupta,SystemSimulationandmodelling, Pearson.2013

ReferenceBooks:

- Deo,Narsingh,MillicanCharlesE.,”SystemSimulationWithDigitalComputer”,PHI.1978
- Gordon,Geoffrey,SystemSimulation,PHI.1977
- P.Radhakrishnan,SSubramanyan,V.Raju,CAD/CAM/CIM,NewAgeInternationalPublishers.2008

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:*Uponsuccessfulcompletionofthiscourse,thestudentwillbeableto:*

- CO1:Describetheroleofimportantelementsofdiscreteeventsimulationandmodelingparadigm.
- CO2:Conceptualizerealworldsituationsrelatedtosystemsdevelopmentdecisions,originatingfromsourcerequirementsand goals.
- CO3:Developskillstoapplysimulationsoftwaretoconstructandexecutegoal-driven systemmodels.
- Interpretthemodelandapplytheresultstoresolvecriticalissuesinarealworldenvironment.
- CO4:*UnderstandthenumericalmethodsinvolvedinFiniteElementTheory.*
- CO5:*Understandtheroleandsignificanceofshapefunctionsinfiniteelementformulationsanduselinear,quadratic, andcubicshapefunctionsfor interpolation.*
- CO6:*RecognizesourcesoferrorsinFEA.*

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

Cos	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1
CO6	PO5/PSO1

BMEE 0306 ADDITIVE MANUAFCTURING

Objective: *The knowledge of this subject will be helpful to students while working in industries.To exploit technology used in additive manufacturing. Objectives of the subjects are to understand importance of additive manufacturing in advance manufacturingprocess. Ease in the selection of techniques and skills to perform relevant additive manufacturingprocess.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM, AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and clean up, post processing. Classification of AM processes: Liquid polymer system, discrete particle system, molten material systems, solid sheet system. Design for AM: Motivation, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features.	23
II	Guidelines for process selection: Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control AM Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries	23

Text Books:

- Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies:Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010

Reference Books:

- Ali K. Kamrani, EmandAbouel Nasr, “Rapid Prototyping: Theory & Practice”, Springer, 2006
- Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles & Applications”, World Scientific, 2003.
- D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of RapidPrototyping and Rapid Tooling, Springer 2001

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Course Outcomes

CO1: Importance of AM in Manufacturing

CO2: Knowledge of Different AM Technologies.

CO3: Design for manufactureusingAMTechniques.

CO4: Identify the use of suitable materials for Additive manufacturing.

CO5: Different methods for Post-processing of AM parts.

CO6: Demonstrate the ability to adhere to personal and industry safety standards.

CO7: Understand the Applications of AM in Automobile, Aerospace, Bio-medicalsectorsetc

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/PSOs
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3
CO7	PO1/PO2/PO12/PSO3

BMEE0307 Computer Integrated Manufacturing

Pre – requisite: Manufacturing Science-II

Objective: *Acquire fundamental understanding of the principles of CAM, including CNC programming, Concept of CIM &Robotics..*

Credits:03 SemesterVI L–T–P:3–0–0

Module No.	Content	Teaching Hours
I	**CIM** Definition, scope and elements of CIM system-benefits, Production system facilities & Manufacturing support systems. **Automation**Reasonsfor Automating, Automation principles and strategies, Basic elements of anautomated system - Levels of automation **NC & CNC TECHNOLOGY:**Fundamental of Numerical Control, Elements of NC Machine Tools, Classification of NC Machine Tools, Advantages and Limitations of NC Machine Tools,Introduction to CNC machine tools, Designation of axis in CNC systems. Feed Back Devices **PART PROGRAMMING:** (A) Manual Programming-G&M codes, Manual part programming for Drilling, Turning andMilling; Canned Cycles.	22
II	**Group technology**Definition, GT-Part family formationClassification and coding-Opitz coding system, Applications & benefits of GT, Cellular manufacturing-Machining cell designs-Machining cell planning, **Computer aided process planning**-Approaches to CAPP-retrieval type CAPP system, generative CAPP system. Computer Aided Inspection and Computer Aided Testing **ROBOTICS:** Robot Anatomy, Laws of Robot, Coordinate system,Specifications of Robot. Power sources, actuators and Transducers, RoboticSensors, Grippers, Robot Safety, Robot Programming and Robot Applications.	22

Text Books:

- Kundra and Rao, “Computer Aided Manufacturing”, TMH, New Delhi.
- Koren, “Computer control of Manufacturing systems”, TMH, New Delhi.
- Groover Mikell P., “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall Publishers.

Reference Books:

- John Stenerson and Kelly Curran, Computer Numerical Control: Operation and Programming, PHI, New Delhi, 2009
- Tien - Chien Chang, Richard A Wysk and Hsu-Pin Wang, Computer Aided Manufacturing, PHI, New Dellhi,2006

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Course Outcome: At the end of the course, a student will be able to

CO1	Understand the need of automation and its strategies used for development in manufacturing.(Understand).
CO2	Describe basic concepts of CAM application and CIM wheel.(Remember)
CO3	Develop manual part programs for machining of complex parts.(Apply)
CO4	Illustrate the basic parts and necessity of Robotic system in Industries.(Understand)
CO5	Understand the concept of group technology& classify using optiz system (Understand &Apply)
CO6	Describe concept of Computer aided Process planning (Understand)

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs):

Cos	*POs/PSOs*
CO1	*PO1, PO2,PO3, PO4/ PSO2*
CO2	*PO1, PO6/ PSO2*
CO3	*PO6/ PSO2*
CO4	*PO1, PO6,/ PSO2*
CO5	*PO1, PO2/PSO2*
CO6	*PO1,PO2/PSO2*

BMEE 0308 Design for Manufacturing & Assembly

Objective: *the aim of present course is to introduce and aware students about the basic design process which based on different aspects of manufacturing as well as assembly.*

Credits:03 **Semester VI** **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**DFMA**: History of DFMA, Steps for applying DFMA during product design, Advantages of applying DFMA during product design, Reasons for not implementing DFMA. **IntroductiontoManufacturingProcess**:Classificationofmanufacturing process, Basicmanufacturing processes & Mechanical properties of material, Classification of engineering materials. **Design for machining**Introductionto machining, Recommendedmaterialsfor machinability, Design recommendations, Design for tuning operation: Processdescription, Typical characteristics and applications, Suitable materials, Design recommendations, Design for machining round holes: Introduction, Suitable materials, Design recommendations.Partsproduced by milling: Process description,Characteristicsandapplicationsofpartsproducedonmillingmachines, Design recommendations for milling,	22
II	**Sand casting**: Introduction to sand casting, Typical characteristics of a sand cast part, Design recommendation for sand casting, Investment casting: Introduction, Steps in investmentcasting,DesignconsiderationofInvestmentcasting,Typicalcharacteristicsand applications. Design for powder metal processing: Introduction to powder metal processing, Typical characteristics and applications,Limitations,Designrecommendations. **Metal Extrusion**: Process, Suitable material for extrusion, Design recommendationfor metal extrusion, Metal stamping: Process, Characteristics and application of metal stamping, Suitable materials for stamping, Design Recommendations for metal stamping. **Introduction to Assembly:**Theassembly process, Characteristics andapplications, DesignforAssembly:Introduction, Design consideration, Design for Fasteners: Introduction, Design recommendation for fasteners.	22

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Reference Books:

- J.Lesko,(1999)IndustrialDesign,MaterialsandManufactureGuide,JohnWillyand Sons,Inc
- GeorgeE.DieterandLindaC.Schmidt(2009),EngineeringDesign,Fourthedition, McGraw-Hillcompanies,NewYork,USA
- GeoffreyBoothroyd,PeterDewhurstandWinstonKnight(2002)ProductDesignfor ManufactureandAssembly,SecondEdition,CRCpress,Taylor&Francis,Florida, USA
- O.Molloy,S.TilleyandE.A.Warman(1998)DesignforManufacturingandassembly, FirstEdition,Chapman&Hall,London,UK.
- D.E.Whitney,(2004)MechanicalAssemblies:TheirDesign,Manufacture,andRolein ProductDevelopment,OxfordUniversityPress,NewYork

- A.K.ChitaleandR.C.Gupta,(1999)ProductdesignandManufacturing,PrenticeHall of India, NewDelhi.
- JamesG.Bralla(1998)DesignforManufacturabilityHandbook,SecondEdition, McGraw-Hillcompanies,NewYork,USA
- GeoffreyBoothroyd(2005)AssemblyAutomationandProductDesign,SecondEdition,CRCpress,Taylor&Francis,Florida,USA

Course Outcome: At the end of the course

CO1	Students will have knowledge on design principles for manufacturability.
CO2	Students will have knowledge on Machining consideration while design
CO3	Students will have knowledge on casting consideration while design
CO4	Illustrate the basic Forming consideration while design
CO5	understand contemporary issues and their impact on design for manufacturing and assembly
CO6	Students will have knowledge Influencing factors on Design

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs):

COs	*POs/PSOs*
CO1	*PO1, PO2,PO3, PO4/ PSO1,PSO2*
CO2	*PO1, PO3/ PSO1,PSO2*
CO3	*PO1,PO3/ PSO1,PSO2*
CO4	*PO1, PO6,/ PSO1,PSO2*
CO5	*PO1, PO2/ PSO1,PSO2*
CO6	*PO1,PO2/ PSO1,PSO2*

BME E0206 MECHANICAL VIBRATION

Pre-requisite: *Theory of Machines*

Objective:

1. *To understand the basic concepts and behavior of vibrations in machines*
2. *To understand the determination of frequencies and other parameters in single degree and two degreevibration systems*
3. *To understand to determine the critical speeds of rotating shafts*
4. *To understand how to apply the different measures for controlling the machine vibrations and noise*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Unit-1: Single Degree of Freedom Systems-Free Vibrations** Introduction to vibration, definitions and basic concepts, degree of freedom, types of vibrations, S.H.M., Fourier analysis. Undamped free vibrations, spring mass system, equivalent stiffness of spring combinations, longitudinal vibrations, transverse vibrations, torsional vibrations; illustrative examples; Damped free vibrations, types of damping, free vibrations with viscous damping, logarithmic decrement, dry friction or coulomb damping, illustrative examples. **Unit-2: Single Degree of Freedom Systems-Forced Vibrations** Forced vibrations with constant harmonic excitation, magnification factor, vibrations with rotating & reciprocating unbalance, vibrations due to excitation of the support, vibrations with coulomb damping, illustrative examples.	19
II	**Unit-3: Two Degree of Freedom Systems** Introduction, principle modes of vibration, spring mass coupled systems, double pendulum, torsional systems; combined rectilinear & angular modes, systems with damping, illustrative examples. Critical speed of a light shaft having a single disc without and with damping, illustrative examples **Unit-4: Vibration Control** Vibration isolation and transmissibility, force transmissibility, motion transmissibility, vibration absorbers, measurement of vibration, vibration measuring instruments, real time frequency processing, vibration control, vibration control for noise reduction, vibration dampers and vibration isolators, illustrative examples.	19

Text Book:

- G. K. Grover," Mechanical Vibrations", Nemchand Publication, New Delhi, 1996
- A. G. Ambekar, "Mechanical Vibrations and Noise Engineering, PHI, New Delhi,2006
- J. D. Irwin & E. R. Graf, Industrial Noise and Vibration Control, PHI, New Delhi, 2002

Reference Books:

- Den Hartog, "Mechanical Vibrations", Dover Publication, New York, 1986
- Hand Book of Noise and Vibration Control, Trade and Technical Press Ltd., England,2014
- L. L. Faulkhar, "Industrial Noise Control", Industrial Press Inc., New York,2010

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the student will be able to:*

- CO1: Ability enhancement in analyzing the machine vibrations in various degree of freedom systems
- CO2: Determining the various causes of machine vibrations
- CO3: Applying the perfect compensatory system to control the vibrations
- CO4: Ability enhancement in practically using the different vibrations measuring instruments
- CO5: Identification of basic causes of machine failures

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO2/PSO1
CO2	PO3/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1

BMEE 0184: MACHINE DRAWING LAB

Objective: *Students have an ability to apply knowledge of Modeling, science & engineering. Student can modelthis drawing even in CAD/CAM software by applying the basic knowledge of machine drawing. Students will ableto demonstrate an ability to design and conduct experiments, analyze and interpret data and assembly anddisassemblydrawingsknowledgewillbeprovided.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**OrthographicProjections**(1drawingsheet) Principleoffirstangleandthirdangleprojection,drawingofmachineelementsinfirst angleprojection, selectionof views, sectionalviews. **Screwedfasteners**(2drawingsheet) Threadnomenclature,Formsofthread,Threadseries,designation,Representation ofthreads,Boltedjoints,Lockingarrangementsofnuts,Foundationbolts. **Keys, Cotter Joint and Pin joint** (1 drawing sheet)Typesofkeys,CotterjointorKnucklejoint. **Shaft Couplings** (1 drawing sheet)Rigid Coupling or Flexible coupling.**Rivetedjoints**(1drawings heet) Typesofrivetheads,Typesofrivetedjoints,Boilerjoint. **AssemblyDrawing**(1drawingsheet) Engine parts-stuffing box, cross head, Assembly drawing of eccentric, lathe tailstock,airvalve, screwjack, connecting rodsafetyvalveetc. **Freehandsketching**(sketchsheet) Free handsketchingoffoundationbolts,studs,pulleys,couplings,helicalgear,bevelgear, crank,connecting rod, beltpulley, pistonetc. **ProductionDrawing**(2drawingsheets) Types,Examplesofsimplemachineelementslikehelicalgear,bevelgear,crank,con necting rod, beltpulley, pistonetc. **ComputerAidedDrafting**(2drawings) Introduction, input, output devices, introduction to software like AutoCAD,Pro-E, basic commands and development of 2D and 3D drawings of simpleparts.	24

TextBooks:

- DhawanR.K,‘ATextBookOfMachineDrawing’: SChand& CompanyPvt.Ltd.NewDelhi,2018.
- Agrawal&Agrawal,C.,‘EngineeringDrawing’ :TataMcGrawHill,2017.

ReferenceBooks:

- JohnK.C.,‘AText BookOfMachineDrawing’:PHILearningPrivateLtd.NewDelhi,2010.
- DhawanR.K,‘ATextBookOfMachineDrawing’:SChand&CompanyPvt.Ltd.New Delhi,2018.
- JunnarkarN.D ‘MachineDrawing’:Pearson India,2006.
- Agrawal&Agrawal,C.,‘EngineeringDrawing’ :TataMcGrawHill,2017.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Afterstudyingthissubjectstudentswillbeableto:*

- *CO1:AnalysiscomplexdesignsystemsrelatedtoMechanicalEngineering.*
- *CO1:Drawtheassemblyfromtheindividualpartdrawing.*
- *CO3:Improvetheirunderstandingofmachinedrawing,whichincludesclearvisualizationofobjects.*
- *CO4:Enhancetheirproficiencyinreadingandinterpretingawidevarietyofproductionandassembly drawings.*
- *CO5: Improve their understanding of drawings of assembled views for the part drawingsusingconventionsandeasy drawing proportions.*

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/ PSO1
CO2	PO1,PO3/PSO1
CO3	PO3/ PSO1
CO4	PO3,PO10/PSO1
CO5	PO3,PO10/PSO1

BMEE0176ADVANCEDSOFTWARELAB

Objective: *Toidentifytheroleofthesoftwareintoday’sDesignworld.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	• UseofPro/EngineerandPro/MechanicalSoftwareforExercisesin:DesignandAnalysisofMechanicalComponentDesignStudiedinSubjectsof MD-IandMD-II. • OptimizationofMechanicalDesignofComponentsandAssemblies. • ReverseEngineeringToolsandTheirUseinComponentDesign. • DesignAutomationandUserDefinedFeatures,AdvancedAssembly. • Structural,Welding,Surfacing,BehaviorModelerandOtherAdvancedModulesUseandDemonstrationof CaseStudies. • ApplicationofFiniteElementMethodstoElasticityProblemsandHeat TransferProblems.UsingANSYS, HYPERMESH,andFEMSoftware’s.	

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: *AttheEndofthecourse,astudentwillableto:*

CO1.*UnderstandtheconceptAutoCAD,Pro/EngineerandANSYS.(Understand)*
CO2.*Designanddrafttheanyworkshoputilitytoolwithapplicationof AUTOCAD/ProE.(Design)*
CO3.*UnderstandtheconceptofdraftingofthetwodailyutilityobjectslikechairandpodiumusingProE/AUTOCAD.(Understand)*
CO4.*DesigntheFlywheelAssemblyusingProE/AUTOCAD.(Design)*
CO5.*UnderstandthefailureconditionofARCweldingjoint.(Understand)*
CO6.*UnderstandtheconceptofanalysisofShaftunderloadusing ANSYS.(Understand)*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO9/PSO1,PSO3
CO2	PO3,PO5,PO9,PO10/PSO1, PSO3
CO3	PO2,PO3,PO9/PSO1,PSO3
CO4	PO3,PO5,PO9,PO10,PO12/ PSO1,PSO3
CO5	PO2,PO3,PO4,PO6,PO9/PSO1,PSO3
CO6	PO2,PO3,PO9/PSO1,PSO3

BMEE0178CAD/CAMLAB

Objective: *ToStudyandacquireknowledgeonvariouscomputerbaseddesigningandmachiningoperationsinspecialpurposemachinesanditsapplicationsinreallife manufacture ofcomponentsintheindustry.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	TotalTENExperimentsaretoCarryOut.FIVEExperimentsEachFromCAD and CAM. **A. CADExperiments** • LineDrawingorCircleDrawingExperiment:WritingandValidationofComputerProgram. • GeometricTransformationAlgorithmExperimentforTranslation/Rotation/Scaling: WritingandValidationofComputerProgram. • DesignofMachineComponentorOtherSystemExperiment:WritingandValidationof Computer Program. • UnderstandingandUseofAny3-DModelingSoftwareCommands. • Pro/E/IdeaEtc.Experiment:SolidModelingofAMachineComponent • Writing A Small Program for FEM for 2 Spring System and Validation ofProgramorUsingAFemPackage. • RootFindingsorCurveFittingExperiment:WritingandValidationofComputerProgram. • NumericalDifferentiationorNumericalIntegrationExperiment:WritingandValidationofComputerProgram. **B. CAMExperiments** • ToStudytheCharacteristicFeaturesofCNCMachine. • Part Programming (in Word Address Format) Experiment for Turning.Operation (Including Operations Such as Grooving and Threading) andRunningonCNCMachine. • PartProgramming(inWordAddressFormatorATP)ExperimentforDrillingOperation(PointtoPoint) andRunningonCNC Machine. • PartProgramming(in Word Address Formator ATP)ExperimentforMillingOperation(Contouring)and Running onCNCMachine. • ExperimentonRobotandPrograms. • ExperimentonTransferLine/MaterialHandling. • ExperimentonDifferencebetweenOrdinaryandNCMachine,StudyorRetrofitting. • ExperimentonStudyofSystemDevicesSuchasMotorsandFeedBackDevices. • ExperimentonMecatronicsandControls.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Uponsuccessfulcompletionstudentsshouldbeableto:*

- *CO1:UseanunderstandingofGeneralandMachine(G&M)codetogenerateoreditaprogram.(Apply)*
- *CO2:Understandtheuseof3-Dmodelsoftwarecommands.(Apply)*
- *CO3:OperateCNClathe&CNCMillingmachines.(Apply)*
- *CO4:UseAdditivemanufacturingequipment3Dscannerandprinter.(Apply)*

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO3/PSO2
CO3	PO1/PSO2
CO4	PO5/PSO2

BMEE0192PROJECTBASEDCAD/CAMLAB

Credits:02 **L–T–P-J:0–0–0-8**

Objectives

- To impart fundamental knowledge to students in the latest technologicaltopics on Computer Aided Design, Computer Aided Manufacturing andComputer Aided Engineering Analysis and to prepare them for taking upfurtherresearchinthe areas.
- Tocreatecongenialenvironmentthatpromoteslearning,growthandimparts abilitytoworkwithinterdisciplinarygroupsinprofessional,industryandrese archorganizations.
- To broaden and deepen their capabilities in analytical and experimentalresearch methods, analysis of data, and drawing relevant conclusions forscholarlywritingand presentation.
- Toprovideguidancetostudentsfortheirchoicesinresearchandprofessionalc areeroutlookandtoencouragestudentstotakeupresearch.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcomes

After completion of this course, students will be able to

- CO1:Apply/developsolutionsortodoresearchintheareasofDesignandsim ulationinMechanicalEngineering.(Apply)
- CO2:Model&Analyzemechanicalcomponentusing3-Dmodelsoftwarecommands.(Apply)
- CO3:ProgrammingonCNClathe&CNCMillingmachines.(Apply)
- CO4:IllustrateUseofAdditivemanufacturing.(Apply)

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO11/PSO2
CO2	PO3/PSO2
CO3	PO1/PSO2
CO4	PO4/PSO2

BMEE0304MODERNMANUFACTURINGPROCESS

Objective:*In this course students acquire the ability to know and understand the advance machines andtheir operations. Students will be able to formulate problems in advanced metal cutting and evaluate thecuttingparameters,establishacompletesolutiontometalcuttingproblemsusingmathematicalorgraphicaltechniques.*

Credits:03 **L–T–P: 3–0–0**

Module	Contents	Contact Hours
1	**Introduction:** Types of advanced manufacturing processes; Evolution, need,andclassificationof advancedmachiningprocesses(AMPs). **MechanicalTypeMMPs:**USM,AJM,WJM,AWJMprocesses:Processprincipleandelements;Tooldesign;Mechanismofmaterial removal,parametricanalysis;Shape andmaterialapplications;Operationalcharacteristics;Limitations. **AdvancedSuperFinishingProcess:**Abrasive Flow Machining;MagneticAbrasiveFinishing;MagnetoRheologicalAbrasiveFinishing:Processprinciple, process equipment; Analysis and modeling of finishing mechanism;Parametricanalysis;Applications. **Chemical Type AMPs:** Process principle and details of Chemical Machining;Photo-ChemicalMachining,andBio-ChemicalMachiningprocesses.	21
2	**Electro Chemical Type AMPs:** ECM-Process principle, mechanism of materialremoval;KinematicsanddynamicsofECM;Toolingdesign;Choiceandanalysisof processparameters;Surfacefinishandaccuracy **Thermal Type AMPs:** EDM, LBM, EBM, IBM, PAM processes: Workingprinciple; Power circuits; Mechanism of material removal; Process parametersandcharacteristics;Surfacefinishandaccuracy:Shapeandmaterialsapplications,limitations. **Derived and Hybrid AMPs:** Introduction of processes like rotary ultrasonicmachining, electro stream drilling, shaped tube electro machining, wire electrodischargemachining,electrochemicalgrinding,electrochemicalhoning,electrochemicaldeburringandelectro-chemicalsparkmachining. **Misc.Topics:**Process selectionandprocessplanningforAMPs.	21

TextBook:

1. Mishra,P.K.,“NonconventionalMachining”,NarosaPublishingHouse.
2. Pandey, P.C.,andShan, H.S.,“ModernMachiningProcesses”, TataMcGraw-Hill.
3. Jain,V.K.,“AdvancedMachiningProcesses”,AlliedPublishers.
4. Benedict,G.F.,“NontraditionalManufacturingProcesses”, MarcelDekker.
5. McGeough, J.A.,“AdvanceMethodofMachining”,ChapmanandHall.
6. Ghosh,A.,andMallik, A.K.,“ManufacturingScience”, AffiliatedEast-WestPress.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:

Studentsareexpectedtolearn:
Oncompletionofthis course,thestudentswould beableto:
CO1.Thestudentwillbeabletoperformadvanceoperationsinmanufacturingprocesses.
CO2.Thestudentwillbeabletoapplyengineeringmathematicsto solvethebasicproblemsofmetalcutting.
CO3.Thestudentwillbeabletohavein-depthknowledgeofmachines,mechanismsandtheiroperationsformaterialremovalusingadvance machines.
CO4Thestudentwillbeabletoperformprocessselectionandplanningforadvancedmanufacturingprocesses.
CO5Thestudentwillbeabletounderstanddifferentoperationsofmanufacturingfordifferenttypesofmachinesandprocesses.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 /PSO2
CO3	PO3 /PSO2
CO4	PO5 /PSO2
CO5	PO4 / PSO2

BMEE0305METALFORMINGANALYSIS

Pre-requisite: *Manufacturing Science I*
Objectives: *To make the students understand the mechanics of metal forming and their behavior undervariousmetalforming processes.*

Credits:03 **L–T–P:3–0–0**

Modul eNo.	Contents	Teachin gHours (Approx.)
I	Reviewoftwodimensionalstressandstrain,stateofstressinthreedimensions,Stresstensor,Invariants,Mohr'scirclefor3-dimensionalstateofstress, strain at a point-Mohr's circle for strain, Hydrostatic & Deviatorycomponents of stress, Elastic stress strainrelations.Elements of theory ofplasticity; Flow curve, True stress & true strain, Yield criteria for ductilemetals, Von Misses & Teresa yield criteria, combined stress tests. The yieldlocus,Anisotropyinyielding,Yield surface, levy-Misses, Prandtl-Reuss Stress-Strain relation, Classification offormingprocessesvariablesinmetalformingandtheiroptimizationAnalysisof deformation processes- Method based on homogeneous compression sliplinefieldtheory,Upperboundsandlowerbounds,Slabmethodofanalysis.	22
II	Flow stress determination, Hot working, Cold working, Strain rate effect,Friction and lubrication, Deformation zone geometry, Workability, Residualstress. Analysis of metal forming processes (only limited portion), Forging: Loadcalculationinplanestrainforging,Rolling:Forces&geometricalrelationshipinrolling,Rollingloadandtorqueincoldrolling,Von-Karmanworkequation,Extrusion: Analysisof extrusionprocess,extrusionpressure,Drawing: Drawingload	20

TextBooks:
- R.HWagoner,Metal FormingAnalysis,CambridgeUniversityPress
- G.W.Rowe,PrinciplesofIndustrial Metal workingprocesses,CBS publishersandDistributors
- B. L.Juneja, FundamentalsofMetal formingprocesses,Newageinternationalpublishers
- GhoshandA.K.Malik, ManufacturingScience, EastWestPress

ReferenceBooks:
- Johson&Mellor,VanNostrand: EngineeringPlasticity.
- Avitzur,McGrawHill:Metalworking.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:
Afterlearningthecoursethestudentsshouldbeableto:CO1
.Identifyvariousformingprocess;

CO2.
Identifyanddeterminevariousyieldcriteriausedinformingprocess;CO3.Lear
n mechanicsofforgingprocesses;

CO4. Learn mechanics of extraction
processes;CO5.Learn mechanicsof
drawingprocesses.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs / PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO1 / PSO2
CO4	PO2 / PSO2
CO5	PO1 / PSO2

BMEE0401INDUSTRIALENGINEERING

Objective:

- *Toenablethestudentsunderstandthedemandforecastingtechniquesandcosting.*
- *Toprovidestudentsaninsightintotheconceptsofindustrialengineeringandorganization.*
- *Tofamiliarizethestudentswithprinciplesofwork-studyandErgonomics.*
- *Tointroducestudentstovariousaspectsofplantdesignandmaterialsplanning.*

Credits:3 **L–T–P-J:3–0–0-0**

Module No.	Content	Teaching Hours
I	**IndustrialOrganization:**Concept,Scope,Objective,Functions,Techniques,&Role ofIndustrial Engineering. MeaningofProductivity,DifferenceBetweenProduction&Productivity,IndducesofProductivity,ReasonsofLowProductivity,Techniques to Improve Productivity. Types of Production, Plant Layout.**Demand Forecasting:** Demand variation, Factors influencing demand,JudgmentalForecast,Timeseries-Rollingaverage,WeightedMovingAverage,Exponentialsmoothing,casualforecast-Correlation,Linearregression,ForecastError. **WorkStudy:** Meaning &BenefitofWorkStudy, Method Study, Recording Techniques-Process Chart, Time scale chart,Flow&StringDiagram,Micro-MotionStudy,SIMOChart,Cycle&ChronoCycle Graph, Time Study- Performance Rating, Allowances, Computation of StandardTime,WorkSampling, PMTS. **MaterialHandling:**Introduction,Objectives,ElementsandPrinciplesofMaterial Handling. **QualityControl:**ProcessControl,SQCCharts,Single,DoubleandSequential AcceptanceSampling,QualityFunctionDeployment.	26
II	**Production Management:** Production Planning & Control, InventoryControl-TypesofInventory,CostAssociatedwithInventory,Deterministic Inventory Models, Inventory Control Techniques, Cost ofProduction,Brake-Even-Analysis. **AdvanceTopicsinProductionManagement:**TotalQualityManagement (TQM)- TQM Approach, Stages of implementation, TQMModel,JustInTime(JIT)Manufacturing–SevenWaste,BasicElements, JITPhilosophy,KanbanSyatem.	14

TextBooks:

- KhannaO.P.,“IndustrialEngineering&Management”,DhanpatRai&Sons.
- ShankerRavi,“IndustrialEngineering”,GalgotiaPVTLtd.
- TelsangMartand,“IndustrialEngineeringandProductionManagement”,S.Chand,New Delhi

ReferenceBooks:

- KoontzH.&DonnelC.O.,“PrincipleofManagement&AnalysisofManagementFunctions”,Tata McGrawHillCo.
- MooreJ.,“ManufacturingManagement”,PrenticeHallEnglewoolcliffs:NewJersey.

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Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Onsuccessfulcompletionofthislab,thestudentswillbeableto:*

- *CO1:ApplyconceptsofIndustrialEngineeringinthefieldofdifferentindustries.*
- *CO2:UnderstanddifferentconceptsregardingOrganizationandProductivityinindustries.*
- *CO3:Anabilitytoidentify,formulates,andsolvesengineeringproblemsbyanalyzingandinterpretingdata.*
- *CO4:Planningandcontrollingofproductionsystemanduseofmodernforecastingandmanagementtechniquesfordifferenttypesofindustries.*
- *CO5:Anabilitytodesign,develop,implement,andimproveintegratedsystemsthatincludepeople,materials,information, equipment, andenergy.*
- *CO6: An understanding of professional and ethical responsibility, ability to use the techniques, skills, andmodernengineeringtoolsnecessaryforengineering practice.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	Pos/PSOs
CO1	PSO2,PO1,PO6
CO2	PSO2,PO1
CO3	PO2,PO9
CO4	PSO2,PO2,PO11
CO5	PSO1,PO3
CO6	PSO3,PO3,PO6,PO8

BMEE0403OPERATIONSRESEARCH

Pre-requisite: *IndustrialEngineering*

Objective:

- *ProvideknowledgeofOPTIMIZATIONapproaches*
- *TodevelopDecision-makingskills.*
- *Providescopetostudentstoresearchmethodsandlatesttrendsinoperationresearch.*
- *Tounderstandthevariousbusinesssituations.*

Credits:03 **L–T–P:3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:**BasicsofOperationsResearch,ApplicationArea,Models,AdvantagesandDisadvantagesofOperationsResearch. **LinearModels:** **Linear programming:** Problem Formulation, Graphical Method, SimplexMethod, Duality in LinearProgramming, Big M-Artificial Variable Method,Degeneracy. **AssignmentProblems:**MathematicalFormulation,HungarianMethodProblem, Degeneracyin Assignment Problem **Transportation:**Matrix Form, Basic Feasible Solution:- North west method,Leastcostmethod,Vogel'sapproximationmethod.OptimumSolution:-MODImethod,Unbalanced-Problems, **DynamicProgramming:**MultistageDecisionProblems&Solutions,PrincipleofOptimality. **Game Theory:**Two Persons Zero Sum Game, Solution With/Without SaddlePoint,propertyof Dominance,Graphical methods	20
II	**Sequencing:**Introduction,Assumption,Johnson'sProcedureforNJobsonTwo MachinesandNJobson ThreeMachines. **Simulations:** Simulation V/S Mathematical Modeling, Monte-CarloSimulation,SimulationLanguages,Uses,Advantagesand Limitations. **InventoryModels:**Variouscostandconcepts,EOQ,Deterministicinventorymodels-productionmodel-Buffer stock **QueuingModels**:Introduction,PoissonandExponentialDistribution,SingleServer andMultiServersModels. **Networks:**BasicConcepts,Constructionofnetworks,RulesforNetworkDrawing,CPMCalculations. Pert Calculations Such As Different Times and Different Floats.Casestudybased2 Miniprojects.	20

TextBooks:

- *GuptaPremKumar,HiraD.S.,"OperationsResearch":S.Chand&Co.*
- *Taha,HamdyA.,"OperationsResearch":PrenticeHallInternationalPublications.*

ReferenceBooks:

- *Wagner,Claire,"PrinciplesofOperationsResearch":PrenticeHallInternationalPublications.*
- *Buffa,Edwood,"ProductionPlanningofOperationManagement":TMHPublications.*
- *Rao,S.S.,"OptimizationTechniques":WileyEasternLimited.*
- *Pradeep.p.Pai,"OperationResearch":OxforduniversityPress.*
- ***Focus:*** *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: **Aftercompletion of thecourse,studentwillbeableto:**

- **CO1:Toimpartknowledgeinconceptsandtoolsof OperationsResearch.**
- **CO2:Applytheknowledge&toolsofoperationresearchinvariousindustries .**
- **CO3:Proficienttorecognizetheimportanceandvalueofmathematicalmodeling in solving practical problems in industry by linear programmingproblems.**
- **CO4: Understand the mathematical tools that are needed to formulate &solvetransportationproblems forcost optimization.**
- **CO5: Understand the process of best strategy using decision making methodsunderuncertainty andgametheory.**
- **CO6: Determine the optimum sequence of n job over 2 and 3 machining bysequencing.**
- **CO7:Understandtheconceptofprojectnetwork,projectscheduleandproject monitoring activitiesby usingCPMand PERTmethod.**

Mappingof CourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs)

COs	**POs/PSOs**
CO1	**PO1,PO2,PO6/PSO3**
CO2	**PO1,PO9/PSO3**
CO3	**PO2,PO11/PSO3**
CO4	**PO5,PO9,PO11/PSO3**
CO5	**PO3,PO4,PO10,PO12/PSO3**
CO6	**PO3,PO5/PSO3**
CO7	**PO8,PO11,PO12/PSO3**

BMEE0404VALUEENGINEERING

Pre-requisite:*IndustrialEngineering*

Objective

2. Understandtheimportanceofvalueengineeringanditsapplicationintheirrespectivefields
3. FamiliarizewiththeprocedureofValueanalysisandValueengineering
4. Implementationofvalueengineering.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**INTRODUCTION:** Meaning of Value Engineering (VE), Value and its types, Relationship between valuevis-a-visperson,timeandenvironment,HistoryofValueEngineering,ValueAnalysis,ValueManagement, Worldbodiesof ValueEngineering&theiractivities, Multi-disciplinaryteamapproachinValueEngineeringstudy. **JOB PLANNING:**Introduction and comparison of jobplansin value engineering, FinanceandhumanrelationsinVE. **ORIENTATIONPHASE:**Trainingassociates in Value AnalysisandValueEngineering(VAVE).DifferenttrainingandcertificationsavailableinVAVE,Methodtoconduct VAVEstudies. **INFORMATIONPHASE**:InformationneededforVAVE,methodtocollectandanalyzeinformation,A B C Analysis, ParetoAnalysis,Breakevenanalysis. **FUNCTIONANALYSIS PHASE**:Breakdownitemintoelementsandsub-elements, Introduction to functions,practicesession,typesoffunctions(useandsellfunction),levelsoffunction(basicandsecondary),identifyvariousfunctions.	22
II	**FUNCTION ANALYSIS PHASE**: Elementsofcost,procedureforcostallocation,costallocationtofunction, concept of worth, process flow for determining worth, discussions on worth, meaning ofFAST, use of FAST, development history of FAST, different types of FAST. Ground rules of FAST,FASTdiagram **CREATIVEPHASE:**Definitionofcreativity,misconceptionsaboutcreativity and introduction tocreativetechniqueslikeTRIZ,3P,lateraladoptionandothers **EVALUATIONPHASE:**Selectioncriteria,feasibilityanalysis,weightedevaluationmethods,decisionmatrix. **RECOMMENDATIONPHASE**:Needforrecommendation,methodtomakepresentation,impactanalysisand justificationreport,implementationplan,presentationskills. **IMPLEMENTATIONPHASE**:Detaileddesign,verificationandvalidation,certification,changeimplementation. **AUDITPHASE**:Needforaudit,typesofaudit,howtoaudit.	22

TextBooks:

- *LawrenceD.Miles,TechniquesofValueAnalysisandEngineering,3rdEdition,NewYork*
- *KR.Chari,Valueengineering,NPC,NewDelhi*

ReferenceBooks:

- *SSIyer,ValueEngineering:AHow-toManual,NewageInternationalPublisher-2"dedition009*
- *AnilKumarMukhopadhaya,ValueEngineeringMastermind:FromConcepttoValueEngineeringCertification.SAGE,NewDelhi*
- *Del.LYonker,Valueengineeringanalysisandmethodology,CRCpress,NewYork*
- *Dr.M.A.Bulsara,Dr.H.R.Thakkar,ProductDesignandValueEngineering,charterpublishers,1st edition2015.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

Aftercompletionofthecourse,studentwillbeableto:

- **CO1:ToimpartknowledgeinconceptsandtoolsofValueEngineering.**
- **CO2:Applytheknowledge&toolsofValueEngineeringinindustries.**
- **CO3:UnderstandtheDifferentphasesofvalueengineeringandtheirsequence.**
- **CO4:Understandandapplythemethodsofjobplanning.**
- **CO5:Analyzetheproductdesign&developmentbyapplyingconceptofvalue engineering.**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program SpecificOutcomes(PSOs)

Cos	**POs/PSOs**
CO1	**PO1,PO2,PO6/PSO2**
CO2	**PO1,PO9,PO11/PSO2**
CO3	**PO1,PO3/PSO2**
CO4	**PO1,PO3,PO5,PO9/PSO2**
CO5	**PO2,PO3,PO11/PSO2**

BMEE0405SUPPLYCHAINMANAGEMENT

Pre-requisite:*IndustrialEngineering*
CourseObjectives:*Toimpartknowledgeandunderstandingtostudentsonsupplychainmanagementanditsrelevancetotoday's businessdecisionmaking.*

- *Develop an understanding of therole of supplychain in amarket-orientedsociety*
- *Examinethemajorfunctionsofsupplychain*
- *Provideanopportunityforcomprehensiveanalysisanddiscussionofkeycontemporaryissues*
- *andproblemsinsupplychainmanagement*
- *Examine the details of planning andcontrolprocesses insupplychainmanagement*

Credits:3 **L–T–P:3–0–0**

ModuleNo.	Contents	TeachingHours (Approx.)
I	**AppliedSupplyChainManagement:**Introduction,Definition, Objectives&Importanceofsupplychainmanagement,complexity&keyissues,Centralizedvs.decentralized systems, Drivers in SCM, SCM decisions andskills, Strategy formulation in SCM, , Bullwhip effect, Push-based,pullbasedsystems **Informationtechnologyinsupplychain:**Valueofinformation ,EnablingsupplychainthroughIT,Criticalbusiness processes and information systems -DBMS,benefits of ERPinformationsystem, RFID **StrategicSourcing:**Sourceevaluation,collaborativeperspective, Buyer-Supplier Relationship, Partner Selection,developofPartnership,importanceofinventory,imbalances,uncertainties,inventorycosts,inventory turnoverration	21
II	**Transportation decision:** Tradeoff, Modes ofTransportation,ModelsforTransportationandDistribution, Factors affecting Network Effectiveness, 3 PL advantages, Bar CodingVendoranalysismodel,CoordinatedSCM,ReverseVsforward supply chain, types of reverse flows, collaborativeSCM'sandCPFR,agilesystems,sourcesofvariability,characteristics,supplierinterface SupplyChainManagementandprofitability,qualitymanagement,masscustomizationandglobalization,ethical SupplyChains,e-businessandSCM,BalancedScoreCard,Benchmarking,Performance measurement	19

TextBooks:

- R P Mohanty,S.G Deshmuki"SupplyChainManagement" Biztantra, NewDelhi,2005
- ChopraandMeindl,SupplyChainManagement2007
- JanatShah,SupplyChainManagement,2016

ReferenceBooks:

- Bowersox,LogisticalManagement,Mc-GrawHill,2000
- SahayBS,SupplyChainManagementforGlobalCompetitiveness,MacmillanIndiaLtd.,New Delhi.
- ReguramG,RangarajN,LogisticsandSupplyChainManagementCasesandConcepts,Mac millanIndia Ltd., NewDelhi,1999.
- Coyle, Bradi&Longby, The Management of Business Logistics, 3rd Ed., WestPublishingCo.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudentwillbeableto:

- CO1:Become familiar with current supply chain management trends Understand and apply thecurrentsupplychaintheories,practicesandconceptsutilizingcaseproblemsandproblem-basedlearningsituations
- CO2:Developasoundunderstandingoftheimportantroleofsupplychainmanagementintoday'sbusinessenvironment
- CO3:Learntouseandapplycomputer-basedsupplychainoptimizationtoolsincludingtheuseofselectedstate ofthe artsupplychainsoftwaresuitescurrently used inbusiness
- CO4:Developandutilizecriticalmanagementskillssuchasnegotiating,workingeffectivelywithina diverse businessenvironment, ethical decisionmakingand useofinformationtechnology
- CO5:Demonstratetheuseofeffectivewrittenandoralcommunications,criticalthinking,teambuilding andpresentationskillsasapplied to businessproblems
- CO6:Successfullycompleteacaseprojectconcludingwithawrittenandoralpresentation ofthefindings

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2/PSO3
CO2	PO1/PSO2,PSO3
CO3	PO5/PSO3
CO4	PO8/PSO3
CO5	PO4/PSO3
CO6	PO3,PO4/PSO3

BMEE 0501 ROBOTICS&FMS

Pre-requisite: *IndustrialEngineering*

Objective: *To introduce the foundations of robotics. Also, a course on Robotics must use one or more softwaretonotonlyvisualizethemotionandcharacteristicsofrobotsbutalsotoanalyser/synthesize/designrobotsfor agivenapplication.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**FundamentalsofRobotTechnology**: Robot definition, automation and robotics, Robot anatomy, Work volume, Drivesystems.Controlsystemsanddynamicperformance.Accuracyandrepeatability. Sensors and actuators used in robotics. Machine Vision, Robotconfigurations,Pathcontrol.Introductiontorobotlanguages.Applications;Types (Mobile,Parallel);Serial:Cartesian,Cylindrical,etc.;SocialIssues **Robot Kinematics**: Mapping, Homogeneous transformations, Rotation matrix,ForwardKinematics(DHNotation)andinversekinematics:Closedformsolution.**Robot Differential Motion:** Linear and Angular velocity of rigid link,Velocityalonglink,Maipulatorjacobian,Statics:Useofjacobian.	20
II	**Robot Dynamics:** Lagrangian Mechanics,LagrangianFormulationandnumericals.Dynamics,Newton-EulerRecursiveAlgorithm,Simulation.Euler-LagrangeEquationsofmotion/Anyoneotherformulation like using Decoupled Natural Orthogonal Complements (DeNOC)**Endeffectors**:Mechanicalandothertypesofgrippers.Toolsasendeffectors.Robotand effectorinterface. Gripperselectionanddesign. **ApplicationsforManufacturing.**Flexibleautomation.Robotcelllayouts.Machineinterference.Otherconsiderationsinworkcelldesign.Workcellcontrol, interlocks. Robot cycle time analysis. Mechanical design of robot links.Typical applications of robots in material transfer, machine loading/unloading;processing operations;assemblyandinspection.	20

TextBook:

- R.K.Mittal,I.J.Nagrath,“Robotics&Control”,TataMcGraw&Hills,2005.
- MikellPGroover,MitchellWeiss “IndustrialRobotics:Technology,ProgrammingandApplication”TataMcGraw&Hills,2009.
- S.K.Saha,“IntroductiontoRobotics”,2nd Edition,McGraw-HillEducation,NewDelhi,2014

ReferenceBooks:

- JohnJ.Craig;“IntroductiontoRoboticsMechanics&Control”,PearsonEducation,2004.
- RobertJ.Schilling,“FundamentalsofRobotics,analysis&Control”,PrenticeHall(I)P.Ltd.,2002
- MarkW.Spong,SethHutchinson,M.Vidyasagar“RobotModelingandControl”JohnWiley2nd Ed
- JSrinivasan,R.V.Dukkipati,K.Ramji,“Roboticscontrol&programming”,Narosa.
- Ghosal,Ashitava,“Robotics:FundamentalConceptsandAnalysis,”OxfordUniversityPress,2006
- M.Murray,M.,Li,Zexiang,Sastry,S.S.,“AMathematicalIntroductiontoRoboticManipulation,”CRCPress, 1994
- Tsai,L.W.,“RobotAnalysis:TheMechanicsofSerial&ParallelManipulators,”Wiley1999
- Niku,S.B.,“IntroductiontoRobotics:Analysis,Systems,Applications”,PrenticeHall,2001

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CO1:Understandthefundamentalsofrobottechnologyfunctionssuchasdynamicperformance,Sensors and actuators used in robotics.

CO2:KnowledgeofMachineVision,Robotconfigurations,Pathcontrollanguages.CO3: Understand of Cartesian, cylindrical, spherical and various application in roboticsCO4:Knowledgeofmodelingforkinematicanddynamicsverificationofanyrobot structureusingsuitablesoftware

CO5:Understandrobotdifferentialmotion, grippersandendeffectors

CO6:Understandofvarioussensors,FMSintegrationandprogrammingforlinearandnonlinearpathin roboticapplications

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PO3/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEE0502:INDUSTRIALAUTOMATION&CONTROLSYSTEMS

Pre-requisite: *Industrial Engineering*

Objective:*Introductiontotheconceptofindustrialautomation,scopeofautomationandstudyofsocio-economic effects. Introduction to the fluid power control and study of the different fluid power systems working.Introduction to the automated material handling system used in automated industry. Study of the workingprinciplemechatronics devicesanddifferenttypesofcontrollers.Introductiontothecontrolsystems*

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:**Concept and Scope of Industrial Automation, Socio-EconomicConsiderations,AndPneumaticLogicCircuits:Un-ComplementationAlgorithm. **Fluid Power Control:**Fluid Power Control Elements and Standard GraphicalSymbols for Them, Construction and Performance of Fluid Power Generators,Hydraulic&PneumaticCylinders-Construction,DesignandMounting,Hydraulic & Pneumatic Valves for Pressure, Flow & Direction Control, ServoValves and Simple Servo Systems With Mechanical Feedback, Simple HydraulicandPneumaticCircuits. **HighVolumeProductionSystems:**TransferDevices&Feeder,Classification, Construction & Application, Automated Flow Lines, Analysis ofAutomatedFlowLinesforReliabilityandEfficiency,AssemblySystems.	22
II	**Mechatronics:**MechanicalSystemInterfacing,SimpleMechatronicsDevices:Servo Motors, Stepping Motors, DC Motors, Analog / Digital Convertors.TypesandFunctionofControllers. Mathematical Modeling of Physical System and Concept of Transfer FunctionSystem.RepresentationThroughBlockDiagramandSignalFlowGraph. Time DomainResponseAnalysisUnderTransientInput&FrequencyDomainAnalysis Root - LocusTechniques,BodePlot.	18

TextBooks:

- Nagrath&Gopal“*ControlSystem*”, McGrawHillEducation;4thedition,2012.
- MajumdarS.R.,“*PneumaticSystems*”,TataMcGrawHill,2017
- SundaramK.Shanmuga,“HydraulicandPneumaticControls”,SChand&Company;1stEdition2006
- JagadeeshaT,“HydraulicsandPneumatics”,DreamtechPress,2019

ReferenceBooks:

- EspositoA., “*FluidPowerwithApplications*”,PearsonEducationIndia;7thedition,2013
- Groover,M.P.,“*Automation,ProductionSystems&ComputerIntegratedManufacturing*”,Pearson Education;Fourthedition, 2016.
- NormanS.Nise, “*ControlsystemEngineering*”Willey,2018.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:Understand**theConstruction,DesignandMounting,Hydraulic&PneumaticValvesforPressure,Flow&DirectionControl,ServoValvesandSimpleServoSystemsWithMechanicalFeedback
- **CO2:**Providehydraulic**solutions**fordesigningautomatedsystems.
- **CO3:Understand**deviseAssemblyautomatedsystemsusingfeeders,orienteersandescapementdevices
- **CO4:Understand**the principle and construction of ServoMotors,SteppingMotors,DCMotorsandAnalog/DigitalConvertors.TypesandFunctionof Controllers.
- **CO5:Design**andimplementelectro-pneumatic/hydraulicsolutionsforautomatedsystems.
- **CO6:Apply**the Mathematical Modeling of Physical System and Concept of Transfer FunctionSystem

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/ PSO3
CO2	PO1/ PSO3
CO3	PO1/ PSO3
CO4	PO4/ PSO3
CO5	PO1/ PSO3
CO6	PO1,PO4/PSO3

BMEE0504ENGINEERINGSYSTEMMODELLINGANDSIMULATION

Pre-requisite:*IndustrialEngineering*

Objective:*Tointroducethestudentsabouttheknowledgeofbasicanddynamicsystemmodelsofengineeringandsimulation system.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**BasicSystemmodels:**Mathematicalmodels,Mechanicalsystembuildingblocks, Electrical system building block, fluid system building block, thermalsystem buildingblock. **SystemModels:**Engineeringsystems,Rotationaltranslationalsystems,Electro-mechanicalsystems, linearity,HydraulicMechanicalsystems. **DynamicResponseofSystems:** Modellingdynamicsystems,Terminology,Firstordersystems,secondordersystems, performance measure of second order systems, system identification.**System Transfer Functions:** The transfer function, first order systems, second order systems, systems inseries,systemswithfeedbackloops,effectofpolelocationontransientresponse.	19
II	**Mechanical Event Simulation (Finite Element modelling and Analysis):**Introduction,Generalprocedureoffiniteelementmethod,finiteelementanalysis,iso-parametricevaluationofelementmatrices,finiteelementmodelling,meshgeneration,designandengineeringapplications.IntroductiontoProEsoftware-Mechanica&dynamicsimulation module. **SystemSimulation:** Introduction, Review of probability and statistics, managing the event calendarina discreteeventsimulationmodel,modellinginputdata. Generation of random numbers and variates, generic features and introductionto Arena Software, Real world applications of simulation, discrete continuoussimulation,verificationandvalidationofsimulation models.	19

TextBook:

- W.Bolton,"Mechatronics–ElectroniccontrolsystemsinMechanical&ElectricalEngineering",PearsonEducationLtd.1868
- IbrahimZeid,"CAD/CAMTheoryandPractice",TataMcGraw-HillPublishingCompanyLimited.1991
- SankarSengupta,SystemSimulationandmodelling, Pearson.2013

ReferenceBooks:

- Deo,Narsingh,MillicanCharlesE.,"SystemSimulationWithDigitalComputer",PHI.1978
- Gordon,Geoffrey,SystemSimulation,PHI.1977
- P.Radhakrishnan,SSubramanyan,V.Raju,CAD/CAM/CIM,NewAgeInternationalPublishers.2008

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Uponsuccessfulcompletionofthiscourse,thestudentwillbeableto:*

- CO1:Describetheroleofimportantelementsofdiscrete eventsimulationandmodelingparadigm.

- CO2:Conceptualizerealworldsituationsrelatedtosystemsdevelopment decisions,originatingfromsourcerequirementsand goals.
- CO3:Developskillstoapplysimulationsoftwaretoconstructandexecutegoal-driven systemmodels.
- Interpretthemodelandapplytheresultstoresolvecriticalissuesin arealworldenvironment.
- CO4:*UnderstandthenumericalmethodsinvolvedinFiniteElementTheory.*
- CO5:*Understandtheroleandsignificanceofshapefunctionsinfiniteelementformulationsanduselinear,quad ratic, andcubicshapefunctionsfor interpolation.*
- CO6:*RecognizesourcesoferrorsinFEA.*

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1
CO6	PO5/PSO1

BME00001TOTALQUALITYMANAGEMENT

Objective: *Study of total quality management will enable the students to develop their mental horizon byenhancing their knowledge and skills which will embed organizational skill & it would be overall beneficial for anyorganization. The main objective is to provide students with quality, organizational and people management skillsandtechniquestoenablethemtomakeasignificantcontributiontoanorganization'squalitypolicy.*

Credits:04 **L–T–P:3–1–0**

Module No.	Contents	TeachingHours
I	**Introduction:** Definition of Quality & Total Quality, World Scenario, QualityEducation, Drivers of Quality, Principles of Quality Management, Internal andExternal Customers, Vision, Mission, Objectives & Targets, Ten Principles ofQuality Management, Evaluation of TQM, Stages of Implementation of TQM, TQMModels. **Quality Planning:** SWOT Analysis, Strategic Planning, Organizational Culture,ManagementofChange. **CustomerOrientation:** Customer Focus,Customer SatisfactionModels,Customer Retention, Measurement of Customer Satisfaction, Quality FunctionDeployment. **QualitySolving Tools:** Process of Solving Problems – ConventionalMethods,7ModernManagementTools. **Continuous Improvement Strategies:** Deming Wheel, Zero Defect Concept,Benchmarking,SixSigma(6σ),Preventive Techniques–FailureMode&EffectAnalysis(FMEA),FiveSofHousekeeping,TimeManagement, TotalProductiveMaintenance	20
II	**Human Dimensions of TQM:** Top Management Commitment, Leadership forTQM, Motivational Strategies, Quality Circles, Team Development & Building,CommunicationandTransactionalAnalysis. **Quality Certification:** ISO 9000 Quality Management System (QMS), ISO14000Series,Qs9000Series,QualityAuditing,QualityAwards,QualityCertifyingAgencies,BusinessExcellenceModels. **Cost of Quality**- Prevention Cost, Appraisal Cost, Internal FailureCost,External Failure Cost, TQM Roadmap, How TQM Fails, TQM ImplementationStrategies. **ContributionofTQMGurus:**W.EdwardsDeming,JuranCrosby,Ishikawa,KaisenandTheirTheoriesforTotalQuality.	20

TextBooks:

- SuganthiL.,A.SamuelAnand,"TotalQualityManagement",PHILearning.
- BediKanishka,"QualityManagement",OxfordUniversityPress.

ReferenceBooks:

- JuranJ.M.,M.GrynaFranic,"QualityPlanningandAnalysis",TataMcGrawHillEdition.
- KumarS.,"TotalQualityManagement",UniversitySciencePress.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Attheendofthecoursethestudentshouldbeableto:*

- *Explainqualityconceptsregardingbasicandadvancedquality.*
- *Describetools&techniques,qualitymanagementsystems,qualityexcellencemethodologies.*
- *Explain continuous improvement methodologies, to the human development and motivation of peopleacross an organization.*

- *DescribeISOqualitystandardusedinindustries.*
- *Understandandexplainconceptofcostofquality.*
- *Illustratecontributionof philosopherlikeDeming,CrossbyIshikawa&KaiseninfieldofTQM.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO4/PSO2
CO2	PO2/PSO2
CO3	PO1/PSO2
CO4	PO7/PSO2
CO5	PO2/PSO2
CO6	PO6/PSO2

BMEO0004PROJECTMANAGEMENT

Objective: *The main objectives of project management are as follows: Understand exactly what a project ismeant to do and what it is meant to deliver. To learn the scope, timescales, cost and quality of a project. How tomaintain a schedule and project plan. To estimate the cost of project. Different finance institute available forfinancial add. Deliver the agreed outcomes of the project to the right scope, timescales, cost and quality. Providecommunications, reports and progress updates throughout the lifecycle of the project. To let students, know howtomanagerisks, issuesand dependencies*

Credits:03 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Project Characteristics, Attributes of A Good Project Manager,TaxonomyofProjects. **ProjectIdentification&Formation:**ProjectIdentification,DemandForecasting, Project Preparation, Zero Based Project Formulation, PreliminaryProjectReport,Comparison ofProjectAlternatives. **Project Appraisal:** Technical Appraisal, Commercial Appraisal, EconomicalAppraisal, Management Appraisal, Social Cost Benefit Analysis, NPV, IRR, BCR,NBCR. **FinancingofProjects:**EstimationofCostComponentsofProjects.Sources of Finances, Role of Financial Institutions, Cash Inflow and Cash Outflow, Cost ofCapital.	20
II	**ProjectPlanning&Scheduling:**SchedulingTechniques,PERT&CPM,NetworkPreparation,UpdatingNetwork,LineofBalanceTechnique,PerformanceAnalysisofProjects,CostVsTimeofCompletion,NormalTimeand Crash Time, Resource Allocation Techniques, Work Breakdown Structure.**ProjectContracts:**TypesofContract,Sub-Contract,Tenders&TypesofPaymenttoContractors. **ComputerAidedProjectManagement:**EssentialRequirementsofSoftware's, Software Packages, Enterprise-Wide Project Management, SpreadSheets. ProjectOrganization,PostProjectEvaluation,ProjectSickness–Causes,Predictionof Causes,Rehabilitation,ProjectAudit,Risk Analysis.	20

TextBooks:

- NagarajanK.,*ProjectManagement*,NewAgeInternationalPublishers.
- PanneerselvamR.&SenthilkumarP.,*ProjectManagement*,PHILearning.

ReferenceBooks:

- PatelBhaveshM,*ProjectManagement*,VikasPublishingHome.
- ScelharamanS.&RamnathVijay,*ProjectManagement*,Breweries;Education.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

Aftercompletionofthe course,studentwillbeableto:

- **CO1:UnderstandtheprojectcharacteristicsandTaxonomyofProject.**
- **CO2:ApplytheknowledgeofDemandForecastinginmanagingthevariousprojects**
- **CO3:UnderstandtheTechnical,Commercial,EconomicalandManagementAppr**

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- **CO4:Understandtheconceptofprojectnetwork,projectscheduleandprojectm onitoringactivities byusing CPMandPERTmethod.**
- **CO5:proficientlyhandlethevarioussoftwarepackagesformanagingtheproject.**
- **CO6: Determine the cost components of Projects and identify different Sources ofFinances**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program SpecificOutcomes(PSOs)

Cos	POs/PSOs
CO1	**PO1/PSO2**
CO2	**PO1,PO2,PO5,PO11/PSO2**
CO3	**PO1,PO11/PSO2**
CO4	**PO8,PO11,PO12/PSO3**
CO5	**PO5,PO11/PSO2**
CO6	**PO1,PO4/PSO2**

BMEO 0005 RELIABILITYANDMAINTENANCEENGINEERING

Objective: *The objective of the course is to provide the students with the fundamental concepts, maintenanceworkload analysis and calculations, maintenance work scheduling the necessary knowledge and the basic skillsrelatedtosystemreliabilityand systemsmaintenancefunctions*

Credits:03 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	Maintenance Management,Production Maintenance System, Objectives andFunctions, Forms, Policy, Planning, Organization, Economics of Maintenance,EvaluationofMaintenance Management. **MaintenanceStrategies:**BreakDownMaintenance,PreventiveMaintenance,PlannedMaintenance,MaintenanceProgramme,JobReport,Strategies. Design Out Maintenance, Planned Lubrication, Total Productive Maintenance,ZeroBreakDownManpowerPlanning,MaterialsPlanning,SpareParts PlanningandControl.	19
II	**ReliabilityEngineering:**Introduction,OperatingLifeCycle,Reliability,Failure Data Analysis, Failure Rate Curve, Hazard Models, Elements in Series,Parallel,Mix,LogicDiagrams,ImprovingReliability,Redundancy-Element,Unit,Standby,Maintainability,Availability,ReliabilityandMaintainabilityTradeOff. BreakDownMaintenancePlanning,ReplacementPlanningMaintainorReplaceDecision,ReplacementModels/Decisions,Individual,GroupReplacement, ReplacementinAnticipationofFailure. **ConditionMonitoring:**ObjectivesandTechniquesofConditionMonitoring.	21

TextBook:

- R. C. Mishra and K. Pathak, "*Maintenance Engineering & Management*": Prentice Hall of India, NewDelhi,2015.
- A. K. Gupta, "*Reliability Maintenance & Safety Engineering*": University Science, Press New Delhi,2009.

ReferenceBooks:

1. Dr.A.K.Gupta,"ReliabilityMaintenance&SafetyEngineering":UniversitySciencePressNewDelhi,2009.
2. KellyandM.J.Harris,"ManagementofIndustrialMaintenance":Boston:Newnes-Butterworths,1979.
3. B.S.Dhillon,"EngineeringMaintainability:HowtoDesignforReliabilityandEasyMaintenance":PrenticeHall ofIndia,New Delhi,1999.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

Aftercompletionofcourse,the student willbe ableto:

- CO1:Understandmaintenanceobjectivesandevaluatemaintenancestrategiesforprocessplantapplications.
- CO2: Evaluate maintenanceschedules and assess the corresponding risks with appropriate tools&techniques.
- CO3: Understand the concept of maintainability & availability and different techniques availableto improvemaintainability &availability.
- CO4:Todevelopthetotaloptimumcostmodelforamaintenanceproblem.

- CO5: Understand the concept of reliability & its techniques for estimating reliability andcharacteristicsofcomponents/systems.
- CO6:Understandandapplytheconceptof reliabilitycentered maintenance(RCM) andadvantagesforacompanyemployingthem.
- CO7: Understand and apply the concept of condition monitoring techniques & its data forpredictivemaintenance.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO1/PO5/PSO2
CO3	PO1/PSO2
CO4	PO3/PSO1
CO5	PO4/PSO2
CO6	PO6/PSO2/PSO3
CO7	PO4/PSO2

BMEE0307 Computer Integrated Manufacturing

Pre – requisite: Manufacturing Science-II

Objective: *Acquire fundamental understanding of the principles of CAM, including CNC programming, Concept of CIM &Robotics..*

Credits: 03 **Semester VI** **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**CIM** Definition, scope and elements of CIM system-benefits, Production system facilities & Manufacturing support systems. **Automation** Reasonsfor Automating, Automation principles and strategies, Basic elements of anautomated system - Levels of automation **NC & CNC TECHNOLOGY:**Fundamental of Numerical Control, Elements of NC Machine Tools, Classification of NC Machine Tools, Advantages and Limitations of NC Machine Tools,Introduction to CNC machine tools, Designation of axis in CNC systems. Feed Back Devices **PART PROGRAMMING:** (A) Manual Programming-G&M codes, Manual part programming for Drilling, Turning andMilling; Canned Cycles.	22
II	**Group technology**Definition, GT-Part family formationClassification and coding-Opitz coding system, Applications & benefits of GT, Cellular manufacturing-Machining cell designs-Machining cell planning, **Computer aided process planning**-Approaches to CAPP-retrieval type CAPP system, generative CAPP system. Computer Aided Inspection and Computer Aided Testing **ROBOTICS:** Robot Anatomy, Laws of Robot, Coordinate system,Specifications of Robot. Power sources, actuators and Transducers, RoboticSensors, Grippers, Robot Safety, Robot Programming and Robot Applications.	22

Text Books:

- Kundra and Rao, "Computer Aided Manufacturing", TMH, New Delhi.
- Koren, "Computer control of Manufacturing systems", TMH, New Delhi.
- Groover Mikell P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall Publishers.

Reference Books:

- John Stenerson and Kelly Curran, Computer Numerical Control: Operation and Programming, PHI, New Delhi, 2009
- Tien - Chien Chang, Richard A Wysk and Hsu-Pin Wang, Computer Aided Manufacturing, PHI, New Dellhi,2006

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: At the end of the course, a student will be able to

CO1	Understand the need of automation and its strategies used for development in manufacturing.(Understand).
CO2	Describe basic concepts of CAM application and CIM wheel.(Remember)
CO3	Develop manual part programs for machining of complex parts.(Apply)
CO4	Illustrate the basic parts and necessity of Robotic system in Industries.(Understand)
CO5	Understand the concept of group technology& classify using optiz system (Understand &Apply)
CO6	Describe concept of Computer aided Process planning (Understand)

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs):

COs	*POs/PSOs*
CO1	*PO1, PO2,PO3, PO4/ PSO2*
CO2	*PO1, PO6/ PSO2*
CO3	*PO6/ PSO2*
CO4	*PO1, PO6,/ PSO2*
CO5	*PO1, PO2/PSO2*
CO6	*PO1,PO2/PSO2*

BMEE 0505 FUNDAMENTALS OF MECHATRONICS AND APPLICATIONS

Objective: "FUNDAMENTALS of MECHATRONICS AND APPLICATIONS", is the combination of mechanical and electronics automation and computers. Nowadays all the mechanical machines have been made computer controlled. The Subject details the basic hardware and software elements used for proper and successful operation of various equipment. The knowledge of this subject will be helpful to students while working in industries.

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Automated Manufacturing System, need of Automation, elements of Automation, levels of Automation. Elements of Mechatronics system, levels of Mechatronics system, Measurement Systems, Control Systems, Microprocessor-based controllers, The Mechatronics Approach., Mechatronics Design Process, real time Mechatronics system and application, advantages and disadvantages of Mechatronics system. **Mechanical Actuating Systems:** Types of motion, Degrees of freedom, constraints, Kinematic Chains, Cam, Gear and gear trains, Ratchet and pawl Belt drive, chain drive, bearing, pre loading. Hydraulic & Pneumatic Actuation Systems: Fluid power systems, hydraulic systems, Pneumatic systems, system structure and signal flow, hydraulic pumps and Pressure Control Valves, air compressors and treatment, Cylinders, Direction Control Valves, Rotary Actuators.	20
II	**Electrical Actuation Systems:** Switching Devices, Mechanical Switches – SPST, SPDT, DPDT, Relays, solenoid operating Valve, Solenoid Operated Hydraulic and Pneumatic Valves, Open and Close loop control system, Control of DC Motors, Permanent Magnet DC Motors, braking of DC Motors, AC Motors, Stepper Motors and Controls. **Sensors, transducers and application:** Performance Terminology, Static and Dynamic Characteristics, Displacement, Position and Proximity Sensors, Potentiometer Sensors, LVDT, Optical Encoders, Hall Effect Sensors. **Programmable logic controllers:** Programmable logic controllers (PLC) Structure, Input / Output Processing, principles of operation, PLC versus computer, selecting a PLC. **Case studies:** Mechatronic approach to design, Possible Design Solutions, Case Studies of Mechatronic Systems. (i.e. Boat Auto pilot, high speed tilting train, automatic car park system, coin counter, engine management system, autonomous mobile system, antilock brake system control, Using PLC	24

Text Books:

- W. Bolton, "Mechatronics – Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd., 2003.
- K. P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics - Integrated Mechanical Electronic Systems, Wiley;

Reference Books:

- Joji P, "Pneumatic Controls", Wiley.
- Dan Necsulescu, "Mechatronics", Pearson
- David g Alciatore, Michael B Histand, "Introduction to Mechatronics and measurement systems", Mc Graw Hill Education.
- A Smaili, F Mrad, "Mechatronics – Integrated Technologies for Intelligent Machines, Oxford Higher Education.
- NitaigourPremchandMahalik, "Mechatronics Principles, Concepts & Application", Tata McGraw Hill Publishing Co.Ltd., 2003.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcomes

CO1: Knowledge of troubleshoot, maintain and repair mechatronic systems using industry-standard tools, practices, and procedures.

CO2: Knowledge of mechanicalactuating systems and their applications in automations.

CO3: Understand the use of electrical and mechanical operated actuators to troubleshoot manufacturing processes and procedures.

CO4: Identify the use of Sensors, transducers for flexible and automated manufacturing.

CO5: Design of Mechatronic system for industry automation.

CO6: Demonstrate the ability to adhere to personal and industry safety standards.

CO7: Communicate effectively across a variety of audiences' technicians, engineers, management, and customers.

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3
CO7	PO1/PO2/PO12/PSO3

BMEE 0309 MANUFACTURING SYSTEMS SIMULATION

Objective:*The objective of the course is to teach methods and techniques for achieving an effective transformation from requirements and business drivers to technology and product design. The ability to create various simulation models of Manufacturing syatems,*Job shop with material handling and Flexible manufacturing systems,

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **INRODUCTION** Concepts in discrete –event simulation, Programming for discrete event simulation in GPSS/MATLAB,development of simulation **Simulation of Material Handling Systems:**Models for varius system like queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network. case studies, verification and validation of simulation models.	22
II	**Unit-II** **Simulation of Mechanical Systems:**Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic and pneumatic systems. **Simulation of Manufacturing Systems:**Job shop with material handling and Flexible manufacturing systems, Simulation software for manufacturing, Structure and development of expert systems.	23

Text Book:

- W. Bolton, "Mechatronics – Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd. 1868
- Jerry Banks and John S Carson, Barry L Nelson, David M Nicol, "*Discrete event system simulation*", Prentice Hall, India,2009.
- Khoshnevi. B., "*Discrete system simulation"*, McGraw Hill International edition,1994

Reference Books:

- Ronald G Askin and Charles R Standridge , "*Modeling and analysis of manufacturing systems*", John Wiley & Sons,1993.
- Gordon G , "*System Simulation*", Prentice Hall, India,1995.
- Thomas J Schriber., "*Simulation using GPSS*", John Wiley & Sons,1991.
- Shannon, R.E., "*System Simulation – The art and science*", Prentice Hall, India, 1993

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the student will be able to:*

- CO1:Conceptualize real world situations related to systems development decisions, originating fromsource requirements and goals.
- CO2:Describe the role of important elements of discrete event simulation and modeling paradigm.
- CO3:Develop skills to apply simulation software to construct and execute goal-driven system models.
- CO4:*Recognize sources of errors in MATLAB.*
- CO5:Simulation and analysis of various manufacturing systems

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
CO1	PO2/PSO1
CO2	PO3/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1

BME E0506 SENSORS AND ACTUATORS

***Objective**: SENSORS AND ACTUATORSis the combination of mechanical and electronics automation system. Nowadays all the mechanical machines have been made computer controlled / automated. The Subject, details the basic structure, design and working of sensors and actuators for proper and successful operation of various equipment in automated system. The knowledge of this subject will be helpful to students while working in industries.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Overview of measurement systems:** Measurement devices; Difference between sensor, transmitter and transducer; Smart device; Primary measuring element selection and characteristics: Range; Response time; Accuracy; Precision; Sensitivity; Dead band; Dead time; Signal transmission: Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Standard signal ranges, Principles of Sensors:Classification of sensors. Characteristics and calibration of different sensors. **Displacement, position and motion sensors:** Principles of variable resistance, variable inductance, variable reluctance, and variable capacitance type sensors. Position and Motion sensors: Limit switches; Proximity sensors: Pneumatic Proximity sensor; Optical Proximity sensor; Inductive Proximity sensor; Capacitive Proximity sensor; Ultrasonic Proximity sensor. LVDT: construction; Working principle; signal conditioning; use of LVDT. Synchros and resolver. Encoders: types of encoder; Hall sensors: Working principle; Hall effect gear tooth sensor. Distance sensors. Light Sensor: Photovoltaic; Photoconductive (Photo resistors). Accelerometer : Definition; General Construction; Working Principle; Types of Accelerometer; Force, Torque, Tactile sensor,Different types of load cells and its application, Piezoelectric transducer, Torque measurement: Tactile sensors. **Strain Gauges:**Working principle; construction; poisson's ratio; Gauge factor, Piezo resistance Coefficient; strain sensing alloys; characteristics; gauges length, rosettes; Types of Strain Gauge. **Pressure sensor**: Few Definition on pressure; static, head, dynamic pressure. Classification of pressure; Pressure Measurement method: U Tube manometer, well type; inclined tube manometer; dead weight; electric strain method. Mechanical pressure measuring elements: Bourden tube. Design and construction of different types of pressure sensing elements. Application of Diaphragm. Electrical and Piezoelectric pressure transducers, McLeod gage, Pirani gage and Ionisation gage.	26
II	**Flow sensors:**The flow pioneers; principle of flow measurement. Types of Flow meter: Differential pressure type; positive displacement type; velocity type; mass meter type. Differential pressure type: orifices; venturi tubes; flow tubes; flow nozzles; pitot tubes; elbow-tap meters; target meters and variable area meters. **Temperature sensor:** Mechanical and Resistance type temperature sensors, Thermocouples, Thermistor, Optical pyrometer, Smart Sensor **Actuators: Definition of Actuators:** Example; selection; Types of Actuators; linear; Rotary; Logical and Continuous Actuators.Pneumatic Hydraulic system: Pneumatic actuator; Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator; Control valves; Construction; Valve coefficient or valve sizing; valve characteristics; types of valves; valve selection. Electrical actuating systems: Solid-state switches, Solenoids, Voice Coil; Electric Motors; D.C. motors, AC motors, Single phase Motor; 3 Phase Motor; Induction Motor; Synchronous Motor; Stepper motors; half stepper; full stepper; linear motor, Piezoelectric actuator.	20

Text Books:

- Sundaram K.Shanmuga, "Hydraulic and Pneumatic Controls", S Chand & Company; 1st Edition 2006
- Nathan Ida, "Sensors, Actuators, and their Interfaces: A multidisciplinary introduction" SciTech Publishing Inc (15 June 2011)

Reference Books:

- Robert H. Bishop, "Mechatronic Systems, Sensors, and ActuatorsFundamentals and Modeling" CRC press 2007
- D.A. Hall, "Sensors and Actuators"CRC Press, 2020
- Clarence W. de Silva, "Sensors and Actuators: Engineering System Instrumentation", Second Edition 2015

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: After completion of course, the student will be able to:

- **CO1:** Explain fundamental physical and technical base of sensors and actuators.
- **CO2:** Describe basic laws and phenomena on which operation of sensor transformation of energy is based**.**
- **CO3:** Analyses various premises, approaches, procedures and results related to sensors and actuators.
- **CO4:** Create analytical design and development solutions for sensors and actuators.
- **CO5:**Design and implement electro-pneumatic/hydraulic solutions for automated systems.
- **CO6:** Conduct experiments and measurements in laboratory and on real components, sensors and actuators.
- **CO7:** Describe development and application of sensors and actuators.

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	**Pos/ PSOs**
CO1	PO1,PO2/ PSO3
CO2	PO1/ PSO3
CO3	PO3/ PSO3
CO4	PO3/ PSO3
CO5	PO1.PO6/ PSO3
CO6	PO1,PO4/PSO3
CO7	PO2,PO6/PSO3

BMEE0179MODERNMANUFACTURINGPROCESSLAB

Pre-requisite:*ManufacturingScience -ILab*

Objective*:Thiscourseintroducesthelatesttechniquesandproceduresforadvancedmanufacturing processes, The Course will provide hands on training of some manufacturingtheory training topics. Sample work will undergo inspection as part of testing to ensure thattheyconform tosetstandards.*

Credits:01 **L–T–P-J:0–0–2-0**

- TodeterminethemetalremovalrateofAJMprocessbycontrollingmachiningparameters.
- TodeterminetheMRRofUSMbycontrollingtheslurryflowratefrequencyandamplitude.
- TodeterminetheMRReffectofelectrolyteflowroleonMRRinECM.
- ToinvestigatethesurfaceroughnessofmachinedsurfacebyEDMundervariableparameter.
- To determine themetalremovalratebyEDMundercontrolparameter.
- TodeterminetheMRRofLBMbyvariableparameter& itseffectonmetalstructure.
- Todesign&manufactureacomponentby3Dprinting.
- ToinvestigatethemachinedzonebywirecutEDM.
- Tofabricate&studyahybridmachining setup (miniproject)

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheend ofthecoursethestudentwill beable
CO1. The student will be able to know the practical skills to work with differentmanufacturingmachines.
CO2.Thestudentwillbeabletoknow thebasicfundamentalsofsomeadvancedimportantmanufacturingoperations.
CO3.The student will be able to know to develop basic know how andawareness to deal with practical aspects of advanced manufacturing operations.CO4.Thestudentwill beableto know aboutthemechanicalpropertiesand theirrequirementsforvariousstructures.

CO5. The student will be able to investigate different modern manufacturingoperations.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO4 / PSO2
CO4	PO3 / PSO2
CO5	PO5 / PSO2

BMEE0193PROJECTBASEDMODERNMANUFACTURINGPROCESSLAB

Pre-requisite:*ManufacturingScience –IandIILabs*

Objective:*This course introduces thefundamentalslatest techniques and procedures foradvancedadvancedmanufacturingprocesses,TheCoursewillprovidehandsontrainingdifferent manufacturing processes. Sample work will undergo inspection as part of testing toensurethattheyconfirm todifferentstandards.*

Credits:02 **L–T–P-J:0–0–0-8**

1. Designandfabricationofmicroabrasivejet formachining brittlematerials.
2. Designandfabricationofselfcenteringtablevicefordrillingmachine.
3. Applicationofjust-in-timemanufacturestrategyinasmallscaleindustry.
4. Designandfabricationofdrilltooldynamometer.
5. Toeloadmeasuringdevice.
6. ApplicationofTaugchitechnique/designofexperimenttohelmentmanufacturingprocess.
7. Designandfabricationofgearcuttingattachmentforlathe.
8. Computeraidedfeatureextractionandcncpartprogramgenerationforrotationalparts.
9. Designandfabricationofmeltingpotforindirectarcfurnace.
10. Designandfabricationofprogressivedie.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: At the end of the course the student will be able

CO1.Thestudentwillbeabletoknow thepracticalskillstodesignandfabricatedifferentmanufacturingprocesses.
CO2.Thestudentwillbeabletoknowtoknowthebasicfundamentalsofdifferentmanufacturingprocesses.
CO3.The student will be able to know to develop basic know how andawareness to deal with practical aspects of advanced manufacturing processes.CO4. The student will be able to know about the programs developed to enhancetheworkingcapability.
CO5. The student will be able to know different advanced machining andmanufacturingoperations.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs / PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO3 / PSO2
CO4	PO3 / PSO2
CO5	PO4 / PSO2

BMEE0182ROBOTICS&FMSLAB

Credits:01 **L–T–P-J:0–0–2-0**

Module No.	Content	Teaching Hours
I	• Developmentofmultiplesensorfusionuseinvariousrobotic application • DemonstrationofarticulatedSCARA,PUMAandotherr obots. • DemonstrationofCartesian,cylindrical,sphericalandvariou sapplicationin robotics • Virtualmodelingforkinematicanddynamicsverificationof anyrobot structureusingsuitable software • Forward, inverse kinematics and trajectory planning forPUMA, SCARA and Stanford using robotics tool box forMATLAB	12
II	• Studyof various sensors integration in roboticapplications • Programming for linear and non linear path using roboticapplication • Simulation of planner and spatial mechanism using multi bodydynamicssoftware. • Design,modelingandanalysisofdifferenttypesofgrippersa ndmanipulators. • Tointroduceanddemonstrateflexiblemanufacturingsystem • TostudyandintegratevariousFMScomponentlikemachines and actuators in differentapplication offactoryautomation • StudyandprogrammingofsensorsintegrationinvariousFMS applications	12

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: At theend ofthiscoursestudents willbe able to

CO1:Understandthefunctionsofmultiplesensorfusionuseinvariousroboticapplication.

CO2:KnowledgeofarticulatedSCARA, PUMAand otherrobots.

CO3:UnderstandofCartesian,cylindrical,sphericalandvariousapplicationinrobotics

CO4:Knowledgeofmodelingforkinematicanddynamicsverificationofanyrobotstructureusingsuitablesoftware

CO5:Knowledgeofforward,inversekinematicsandtrajectoryplanningforPUMA,SCARA and Stanford usingrobotics toolboxforMATLAB.

CO6:Understandofvarioussensors,FMSintegrationandprogrammingforlinearandnonlinearpathin roboticapplications

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO3/PO12/PSO3
CO3	PO1/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEE 0196 PROJECT BASED ROBOTICS & FMS LAB

Credits:02 **L–T–P-J:0–0–0-8**

Module No.	Content	Teaching Hours
	• Study of DTMF Controlled Robot without Microcontroller: The mainaimofthisprojectistocontrolaroboticvehiclebygivingtheinstruction through mobile phone using DTMF technology. This canbeusedforsurveillancesystemsandindustrialapplications. • Study of Microcontroller Based Line Following Robot : This projectillustrates the concept of tracking or following the path specified to aroboticvehicleusingAVRmicrocontroller.ThisprojectusesIRsensorto detect thepath specified bytheuser. • Study of PC Controlled Human Detection Robot: This project aims todetect the humans through a robotic vehicle by using IR sensors andmicrocontroller unit. This project is very helpful in the time of earthquakesto detect the personnel. • StudyofMetalDetectorRobotUsingMicrocontroller:AMetaldetectorrobotisusefultosensethemetalsinthepathaheadofit.This will be necessary requirement in case land mines detection. Sothis project meets the requirement with simple microcontroller basedrobot. • Study of Obstacle Avoiding Robot: This is an autonomous intelligentrobotwhichisbuiltwithinfraredsensorstosensetheobstaclescoming in the path of the robot and correspondingly changes thedirectionofthe robot. • StudyofAutomaticFireSensingandExtinguishingRobot:Thisproject aims to develop a multi flame sensor based fire fighting robot.If the fire takes place, the robot moves towards the fired area andstartssprinklingthewaterfrom waterpump attachedtoit. • StudyofAutomatedSystemDesignforMetroTrain:Thisisanautomated system for a metro train which announces the station nameand displays the relevant information when train arrives at particularstation.Inthis,RFIDtags areusedfortrackingthestationdata. • Study of Color Guided Material Handling Robot: The main idea of thisprojectistobuildacolordetectingrobotwhichseparatestheobjects	24

	thataremovingonaconveyerbeltinanindustry.Thisprojectuses	
	MATLABtodevelopcolordetectivealgorithm. • Study of Arduino Based Smart Boat with Obstacle Detection: This is asimpleDIYprojectwhichhelps todesignaboatwithadditionalfeatureslikelight guidedcontrolandobstacledetection. • Study of Design of Microcontroller Based Edge Avoider Robot : Thisproject implements a robot which can avoid edge by detecting earlyandtakesfurtheractionintime.Thisprojectalsoincludespathfinding,obstacledetectionand linefollowercapabilities.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: At theend ofthiscoursestudents willbe able to

CO1:Understandthefunctionsofmultiplesensorfusionuseinvariousroboticapplication.

CO2:KnowledgeofDTMFControlledRobotwithoutMicrocontroller,PUMAandotherrobots.

CO3:UnderstandtheworkingofAutomatic FireSensingandExtinguishingRobot

CO4:KnowledgeofmodelingforkinematicanddynamicsverificationofstructureusingsuitablesoftwareforObstacle AvoidingRobot.

CO5:Knowledgeofforward,inversekinematicsandtrajectoryplanningforPUMA,SCARAand Stanford usingrobotics toolboxforMATLAB.

CO6:UnderstandthevarioussensorsandtheirapplicationsinMetalDetectorRobotUsingMicrocontroller.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO12/PSO2,PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO3
CO4	PO1/PO2/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEE0001REFRIGERATIONANDAIRCONDITIONING

Pre-requisite: *AppliedThermodynamics*
Objective: *Tostudytheworkingofdifferent RefrigeratingandAirConditioningSystem&Analysisoftheirperformanceparameters.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Refrigeration:** IntroductiontoRefrigeration&MethodsofRefrigeration,Carnot RefrigerationCycleandItsLimitations,C.O.P. **Refrigerants:** ClassificationofRefrigerants,Nomenclature,DesirableProperties of Refrigerants, Secondary Refrigerants and CFC Free Refrigerants.GreenHouse Effect. **AirRefrigerationCycle:** OpenandClosedAirRefrigerationCycles,Reversed Carnot Cycle, Bell Coleman or Reversed Joule Air Refrigeration Cycle,Aircraft Refrigeration System, Classification of Aircraft Refrigeration System.BootStrapRefrigeration,Regenerative,ReducedAmbient,DryAirRatedTemperature(DART). Refrigerant Compressors; Classification, workdone, thermodynamic process,volumetricefficiency,principaldimensionsofreciprocatingcompressors, performancecharacteristics, **Vapour Compression System:** Single Stage System, Analysis of VapourCompression Cycle, Effect of Pressure, Sub Cooling & Superheating on C.O.P oftheCycle.Actual VapourCompressionRefrigerationCycle.	22
II	**MultistageVapourCompressionSystem**:RemovalofFlashGas,Intercooling,DifferentMultistageSystem, CascadeSystem. **VapourAbsorptionSystem:** WorkingPrincipleofVapourAbsorptionRefrigerationSystem, Ammonia– WaterVapourAbsorptionSystem, **AirConditioning:** IntroductiontoAirConditioning,PsychometricProperties and Their Definitions, Different Psychometric Processes, ThermalAnalysis of Human Body, Effective Temperature and Comfort Chart, CoolingandHeating LoadCalculations. Infiltration & Ventilation, Internal Heat Gain, Sensible Heat Factor (SHF), byPass Factor, Grand Sensible Heat Factor (GSHF), Apparatus Dew Point (ADP).ElementaryKnowledgeofTransmissionandDistributionofAirThroughDucts. **RefrigerationEquipment&Application:** AirWashers,FoodPreservation, Cold Storage, Refrigerator, Ice Plant, Water Coolers, CentralizedA.C.	21

TextBooks:

- PrasadManohar,"*RefrigerationandAirconditioning*",NewAgeInternational(P)Ltd.Pub.
- C.P.Arora,"*RefrigerationandAirconditioning*", TMH.
- AroraandDomkundwar,"*RefrigerationandAirconditioning*",DhanpatRai&Co.

ReferenceBooks:

- StoeckerandJones,"*RefrigerationandAirconditioning*",TMH.
- RoyJ.Dossat,"*RefrigerationandAirconditioning*", PrenticeHallIndia.
- P.L.Baloney,"*RefrigerationandAirconditioning*",SNTI,Publications.
- Kuhen,Ramsey&Thelked,"*ThermalEnvironmentEngg*",CentralBookAgency.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: At theendofthecourseastudent will be able to

- O1:illustrate thefundamentalprinciplesofrefrigerationandairconditioningsystems.
- CO2:understanddifferentproperties,designationandenvironmentalissuesofrefrigerants
- CO3:understandtheworkingofvapourcompressionandvapour absorptionrefrigerationsystems..
- CO4:determinethecoolingcapacityandCOPofrefrigerationsystem.
- CO5:analyzetheperformanceof psychometricprocessesusedforhumancomfort.
- CO6:determinethecoolingload/heatingloadforagivenairconditioningapplication.
- CO7:understand theworkingofIceplantandcoldstorage,airwasher.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO10/PSO1
CO2	PO1,PO7,PO12/PSO1
CO3	PO1,PO10/PSO1
CO4	PO1,PO4,PO10/PSO1
CO5	PO1,PO4,PO6,PO10/PSO1
CO6	PO1,PO4,PO10/PSO1
CO7	PO1,PO10,PO12/PSO1

BMEE0170REFRIGERATIONANDAIR-CONDITIONINGLAB

Objective: *TomakestudentsfamiliarwiththevariousdevicesassociatedwithRefrigeration&Air-Conditioning.Theexperimentsaredesignedtoprovideexposureofpracticalaspectsofthevarioustheoreticalconceptsdevelopedduringtherefrigerationandairconditioningcourse.*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	List ofExperiments: • ToStudyBasicComponentsofAir-ConditioningSystem. • ExperimentonRefrigerationTestRigandCalculationofVariousPerformanceParameters. • ToStudyDifferentTypesofExpansionDevicesUsedinRefrigerationSystem. • ToStudyDifferentTypesofEvaporatorsUsedinRefrigerationSystems. • ExperimentonAir-ConditioningTestRig&CalculationofVariousPerformanceParameters. • ToStudyAirWashers. • StudyofWindowTypeAirConditioner. • VisitofaCentralAirConditioningPlant andItsDetailedStudy. • VisitofCold-StorageandIts Detailed Study. • ExperimentonIce-Plant toFind OuttheCapacityofPlant. • Experiment on Two Stage Reciprocating Compressor forDetermination ofVolumetric Efficiency,PVDiagram. • StudyofCompressors- HermeticallySealed. • ExperimentonDesertCoolers. • StudyofCentralAir-ConditioningSystems	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Oncompletionofthelabstudentswillbeableto*

- CO1:illustratethefundamental workingprinciples ofvapourcompressionrefrigerationsystem.
- CO2:recognizethecomponents(expansiondevices,evaporators,condensers,compressors)andunderstandtheiruseinrefrigerationsystem.
- CO3:illustratetheworkingofvapourcompressionandvapourabsorptionrefrigerationsystems.
- CO4:analyzetheperformanceparametersofvapourcompressionandvapourabsorptionrefrigerationsystems.
- CO5:analyzetheperformanceof psychometric processesusedinairconditioning.
- CO6:developprototypemodel ofrefrigerationsystemusedinIceplants,airwasher.
- CO7:determinethecapacityofwindowand splitairconditioningsystem.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO10/PSO1
CO2	PO1,PO10,PO12/PSO1
CO3	PO1,PO10/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4,PO6,PO9,PO8,PO10/PSO1
CO6	PO1,PO4,PO10,PO12/PSO1
CO7	PO1

BMEE0002INTERNALCOMBUSTIONENGINE

Pre-requisite: *AppliedThermodynamics*

Objective: *The objective of this course is to give an introduction of internal combustion engines with emphasison their engineering applications. The focus is on explaining engine performance in terms of power, energyutilizationandexhaustemissions,itsrelationtointernalprocesseslikecombustionandvaryingengineoperating conditions.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to I.C. Engines**: Engine classification and basic terminology,Two and four stroke engines, SI and CI engines, Valve timing diagram, Engineperformanceparameter.ThermodynamicanalysisofAirstandardcycles,Ottocycle,Dieselcycle,Dualcycle,ComparisonofOtto,DieselandDualcycles. Introduction to Fuel air cycle & Actual cycle, factors affecting the fuel air cycle&Actual cycle. **SI Engines:** Combustion in SI engine, Stage of Combustion, Flame speed,Ignition delay, Abnormal combustion and its control, combustion chamberdesignforSIengines,Carburetor,Carburetion,Mixturerequirements,CarburetorsandfuelinjectionsysteminSIEngine,Ignitionsystemrequirements,Magneto andbatteryignition systems.	23
II	**CI Engine:** Combustion in CI Engines, Ignition Delay, Knock, AbnormalCombustion, Combustion chamber design of CI engines, Fuel Injection SystemofCIEnginesandTheirComponents, Injection Timings. **Fuels:** Fuels for SI and CI engine , Important qualities of SI and CI enginefuels, Rating of SI engine and CI engine fuels, Gaseous fuels, LPG, CNG, Biogas,AlternativefuelsforICengines,NormslikeEuroandBharatNorms. **Supercharger&Turbocharger***:*Introductiontosuperchargerandturbocharger,TypesofSuperchargingMethods,CalculationofSupercharger. BasicConceptsofAdvancedEngines.	22

TextBooks:

- Mathur&Sharma,"*ACourseinInternationalCombustionEngines*",DhanpatRai&Sons.
- R.Yadav,"*I.CEngine*",CentralPublishingHouse,Allahabad.
- Ganeshan,"*I.CEngine*",TataMcGrawHillPublishers.

ReferenceBooks:

- Gill,Smith&Ziurs,"*FundamentalsofInternalCombustionEngine*",Oxford&IBHPublishingCo.
- Rogowsky,"*ICEngines*",InternationalBookCo.
- E.FObert,"*I.CEngineAnalysis&Practice*",S.Chand.
- Engineering Fundamentals ofInternalCombustionEngines byW.W. Pulkrabek,PearsonEducation.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:**Recognize and understand the reasons for differences among operating characteristics of differentenginetypesanddesigns.
- **CO2:** Analysis of different power cycle of internal combustion engines using ideal gas cycles, air

cycles,and fuel-aircycles.

- **CO3:** Characteristic of homogeneous combustion in SI-engines and spray combustion in CI-engines. FuelqualityrequirementsofSI-andCI-engines.
- **CO4:**Fueleconomytrends withitshistoryandnorms.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO3,PO4/PSO3

BMEE0004POWERPLANTENGINEERING

Pre-requisite: *AppliedThermodynamics*
Objective: *Tomakestudentconversantwith variouscomponentsandoperationsofdifferentpowerplantsandpowerplanteconomics..*

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** The Sources of Energy, Development of Power Generation inIndia,RankingCycle,Reheat.Regeneration. **Power Plant Economics and Environmental Considerations**:Costsofpowergeneration,GeneralArrangementofPowerDistribution,LoadCurves, Load Duration Curve, Economic Scheduling, Definitions of ConnectedLoad,MaximumDemand,DemandFactor,AverageLoad,LoadFactor,DiversityFactor–RelatedExercises. **EffluentsFromPowerPlant:**ImpactonEnvironment,PollutantsandPollution Standards,MethodsofPollutionControl. **Steam Power Plant**: Plant Layout, Working of Different Circuits, Types ofcoal, Coal Handling, Dust and Ash Handling Systems.**Combustion Process:** Coal Stokers, Pulverized Fuel Burning System and ItsComponents,CombustionNeeds andDraughtSystem,CycloneFurnace. Feedwatertreatment,PlantAuxiliaries**.**	20
II	**HydroElectricPowerPlant**:HydrologicalCycle,Hydrographs,.PlantClassification, Typical Layouts, Plant Auxiliaries, Classification of Dams andSpillWays, PlantOperation. **NuclearPowerStation**:NuclearFuels,NuclearReactors,ReactorOperation.PressurizedWaterReactor,BoilingWaterReactor,Sodium-Graphite Reactor, Fast Breeder Reactor, Homogeneous Reactor, Gas CooledReactor,RadiationHazardsandShielding–RadioactiveWaste Disposal. **Gas Turbine Plant**: Introduction, Classification, Construction – Layout WithAuxiliaries, Principles of Working of Closed and Open Cycle Gas power plant.CombinedCycle PowerPlantsandComparisons. **PowerFromNon-ConventionalSources**:Solarenergy.WindEnergybasedpowerplant-PrincipleofWorking,,MHDpowerGeneration.	22

TextBooks:
- P.K.Nag,“*PowerPlantEngineering*”:TataMcGraw-HillPublishingCompany,Ltd.
- P.C.Sharma“*PowerPlantEngineering*”,S.K.Kataria Pub.

ReferenceBooks:
- M.M.ElWakil,“*Power PlantTechnology*”:TataMcGraw- HillPublishingCompany,Ltd.
- A.J.WoodandB.F.Wollenberg“PowerGenerationOperationandControl”:Wiley.
- G.D.Rai,“Non-ConventionalEnergySources”:KhannaPublishers.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Afterthecompletion ofcourse,Students willbeableto:
- CO1:describethelayoutandcomponentsofthermalpowerplant.

- CO2:analyzetheperformanceof thermalpower plant basedontheRankincycle.
- CO3:describethelayoutandcomponentdetailsofhydroelectricpowerplant.
- CO4:describethelayout,componentdetailsofgaspowerplantandnuclearpowerplant.
- CO5:analyzetheperformanceof gaspower plantbasedontheBraytoncycle.
- CO6:understandthebasicprinciplesofeconomicsofpowergenerationandenvironmentalhazardsofpowe rplants.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSO s):

COs	POs/PSOs
CO1	PO1,PO10,PO12/ PSO1
CO2	PO1,PO2,PO4/PSO1
CO3	PO1,PO10/ PSO1
CO4	PO1,PO6,PO7,PO10/PSO1
CO5	PO1,PO2,PO4/PSO1
CO6	PO1,PO7,PO10/PSO1

BMEE0005GASDYNAMICS

Pre-requisite:*AppliedThermodynamics*

Objective: *The main objective of the course is to provide an insight into the applications of compressible flowand to enable the students formulate and solve problems in one dimensional steady compressible flow includingisentropic nozzle flow, constantareaflowwithfriction or with heattransfer.*

Credits:04 **L–T–P:3–1–0**

Module No.	Content	TeachingHours
I	**Basics of Fluid Mechanics**: Conservation laws for mass and Momentum,Velocity of sound, Bulk modulus of elasticity, Coefficient of Compressibility,Stagnation state, Critical state, Various regions of flow, Differences betweenIncompressibleandCompressibleflows,Reynoldsnumberanditssignificance.**Fundamentals of compressible flow:** Objective and applications ofcompressible flow, Ideal gas relationship, The adiabatic energy equation,Physical significance of Crocco number and Mach number, Characteristic Machnumber, Critical Mach number, Mach waves, Mach cone and Mach angle, staticand stagnation states, relationship between stagnation temperature, pressure,density and enthalpy in terms of Mach number, stagnation velocity of sound,reference speeds, various regions of flow, Effect of Mach number oncompressibility, Area velocityrelationship. **Isentropic flow through a variable area duct**: General features of isentropicflow, performance curve, Comparison of adiabatic and isentropic process, Onedimensionalisentropicflow inductsofvaryingcross-section-nozzlesanddiffusers, operation of nozzles under varying pressure ratio, Mach numbervariation, Area ratio as a function of mach number, Impulse function, Massflowratethroughnozzlesanddiffusers,Phenomenonof choking,subsonic and supersonicdesigns.	22
II	**Flowthrough constantareaductswithfriction:**Objective,outcomeandassumptions of Fanno flow,Fanno curves, Equation andits solution,Variationofflowpropertieswithductlength.Isothermalflowwithfriction, Variationofflow properties. Tables and charts for Fanno flow. Applications of Fanno flow.**Flowthroughconstantareaductswithheattransfer**:Rayleighflow,Rayleighflowequation,Rayleighline,Variationofflowproperties,Maximumheattransfer. Basic formulation of non Isothermal flow with heat transfer and friction**Normal Shock Gas Dynamics:** Development of shock wave, governingequations,Prandtl–Meyerrelation,RankineHugoniotrelation,Impossibilityofrarefaction shock, Mach number downstream of shock, Property variationacrossshock,Strengthofshockwave,entropychange,supersonicdiffuser. NormalshocksinFannoandRaylighflow.Introductiontoobliqueshockflow.	21

TextBooks:

- *1.FundamentalofCompressibleflow,S.M.Yahya,NewageinternationalPublication,Delhi*
- *2.Fundamentalsofcompressiblefluiddynamics-P.Balachandran,PHILearning,NewDelhi*
- *3.GasDynamics,E.Rathakrishnan,PHILearningPvt. Ltd*

ReferenceBooks:

- *1.ThedynamicsandthermodynamicsofCompressiblefluidlowVolume-I,AscherH.Shapiro,theRonaldPressCompany,NewYork.*
- *2.GasDynamicsandJetPropulsion-P.Murugaperumal,ScitechPublication,Chennai.*
- *3.ModernCompressibleFlow:WithHistoricalPerspective,JohnD.Anderson,McGraw-HillHigherEducation*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:**Conceptsandresultsforthecompressibleflowofgasesandintroductiontothenumericalmethodof characteristics.
- **CO2:**Conservationlaws,propagationofdisturbances,isentropicflow,compressible flowinductswithareachanges, normal and obliqueshockwavesandapplications.
- **CO3:**Prandtl-Meyerflow,FannoflowandRayleighflowwithapplicationstonozzlesandonedimensionalunsteadyisentropic flow
- **CO4:** physicalunderstanding ofthe phenomena andbasicanalyticalresults.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO4/PSO3

BMEE0006GASTURBINEANDJETPROPULSION

Pre-requisite:*AppliedThermodynamics*

Objective: *Students will be able to understand propulsion systems in aircraft that are essential to graduateengineers who are intended to work in aircraft system/component manufacturing/maintenance environments.Students should be able todescribe thekeyaeronautical engineering featuresin the contextofwhichtherelevant industryoperates.*

Credits:04 **L–T–P:3–1–0**

ModuleNo.	Content	TeachingHours
I	**IntroductiontoGasTurbine:**SimplegasturbineandreviewofBraytoncycle. **CycleArrangements:**Opencyclearrangement,closedcyclearrangement. Basicrequirementsofworkingmediumanditsproperties. **Idealcyclesandtheiranalysis:**Simplegasturbinecycle,heatexchange cycle, reheat cycle, intercooled cycle, combinations of variouscycles,comparisonof variouscycle. **Impulseturbineandreactionturbines:**Introductiontoimpulseturbineandreactionturbines,Multistagemachine,compoundingofturbines.	22
II	**Elementary turbine design:** Velocity triangleofsinglestageturbine,Expressionforworkoutput,bladeloadingand flowcoefficients,bladeand stage efficiencies, Blade to gas speed ratio, losses and efficiencies.**Aircraft Propulsion:** Introduction, types ofaircraftenginesandtheiranalysis(gasturbineengines,turbojetengines,turbofanengines,turbopropengines) **Aircraftpropulsiontheory:**Thrust,thrustpower,propulsiveefficiency,ram efficiency,thermalefficiencyandoverallefficiency.	23

TextBooks:

- CohenandRogers,'GasTurbineTheory',DorlingKindersley(India)pvt.Ltd.,Noida.
- V.Ganesan,'GasTurbines',TataMcGrawHills,NewDelhi.
- S.M.Yahya,'Turbines,Compressorsandfans',McGrawHills,NewDelhi.

ReferenceBooks:

- JackD.Mattingly,'ElementsofGasTurbinePropulsion',TataMcGrawHills,NewDelhi.
- Mathurand Sharma,'GasTurbineandJet&RocketPropulsion',Standardpulishers,Delhi.
- AhmedandSayed,'AircraftpropulsionandGasTurbineEngines'CRCpress,TaylorandFrancis.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:**Outlinegoverningequationsofcompressiblefluidflow.
- **CO2:**Analyzeonedimensionalcompressibleflowthroughvariableareaduct.
- **CO3:**Analyzecompressibleflowhavingnormalshock.
- **CO4:**Applygoverningequationstocompressibleflowthroughconstantareaduct withfriction.

- **CO5:**Applygoverningequationstocompressible flowthroughconstantareaductwithheattransfer.
- **CO6:**Interpretpropulsivesystemsfortheir workingandapplication.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO4/PSO3
CO4	PO2,PO4/PSO3
CO5	PO2,PO3/PSO3
CO6	PO3,PO4/PSO3

BMEE0007ADVANCEDHEATTRANSFER

Pre-requisite:*Heat&MassTransfer*

Objective: *Todevelop theunderstanding ofstudents tosolve the reallife applicationsbyapplyingthelawsofheattransfer.Analysisofheattransfermechanismsincombined modesofheattransfer.*

Credits:04 **L–T–P:3–1–0**

ModuleNo.	Content	Teaching Hours
I	TransientHeatConduction,Convection,NumericalSolutionofConductionproblemsandMassTransfer,Finitedifferenceequations method of energy balance, finite difference formulationof unidirectional for Cartesian cylindrical coordinate of variouskindofboundaryconditions,heatconductionproblems,numerical methods of solutions, numerical solution of transientheatdiffusionproblems.EmpiricalcorrelationsofFreeandforcedheat transfer. Heat exchanger heat transfer problems. Thermalboundarylayer thickness.	22
II	Convectivemasstransferequationsandtheirapplications.Boundary layermasstransferempiricalcorrelationsforconvectivemasstransfer. Heat Transfer by Radiation, Boiling and Condensation, nucleatepoolboilingandempiricalcorrelationsforpoolboilingheattransfer, factors affecting pool boiling film coefficients, high heatfluxboiling.Laminarfilmcondensationonaverticalplate,turbulentfilmcondensation,dropswisecondensation.	23

TextBooks:

- J.P.Holman"HeatTransfer"Mac-GrawHillspublication,2017
- YadavR.,"*HeatTransfer*",CentralPublishingHouse,Allahabad,2018

ReferenceBooks:

- Bayazitouglu&Ozisik, "*ElementsofHeat transfer*",T.M.H.,2015
- Pitts&Sisson,"*Schaum'soutlineofHeatTransfer*",McGraw-HillInternationaledition,2018
- Frank Kreith,"*PrinciplesofHeatTransfer*",McGraw-HillBookco.,2019

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

OUTCOMES: Aftercompletionofcourse,thestudentswillbe ableto:

- Determinetheheattransferthroughcompositewallofa Furnaceundergivenboundaryconditions.
- Determinethenumericalheattransferofcompositesystemundersteadystateconditionofheattransfer.
- Determinethenumericalheattransferofcompositesystemunderun-steadystateconditionofheat transfer.
- Establishempiricalrelation foragiven heattransferapplication.
- Understandmassdiffusion rateincaseofevaporativecooling incoolingtowers.
- Understandthe effectsoffoulinginboilertubesofthermalpowerplant.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO1,PO2/PSO1,PSO2
CO6	PO1,PO2/PSO1,PSO2

MEE0008 SOLAR ENERGY

Credit:03 **L-T –P-J:3-0-0-0**

Course objective: Solar energy is ultimate energy resource available on planet earth. Objective of this course is to makestudents aware about many facets of solar energy. How solar energy can be harnessed for variousapplications. Ultimate objective of this course is to train students about integration of solar energydevicesinbuildings,agriculturalandothermechanizedmeans.

Module No.	Content	Teachin gHours
I	**Introduction:**generalintroductiontorenewableenergytechnology,Solarenergypotentialin India, energy demands and renewable energy. current and future scenario.**Solarradiation**:Directanddiffusedradiation,Radiationmeasuringequipment.Basics ofsolarangles. **Solarcollectors**:basicworkingofcollectors,FPSC,PTC,Solarconcentrators, , tracking mechanism,Solar energy storage systemsdesignsandperformanceanalysisbased onstandard norms. **Applications** in water heating systems, steam generating with solarenergy.Phase changingmaterialsforenergystorage	20
II	Solarairheatingsystems,Spaceheatingandcoolingprocesses PV Systems,hybrid PV/Tsystems.Renewableenergy desalinationsystems.Energyconversionsystemsbasedonbio-mass,Photosynthesisbasic conceptandworkingoffuelcell. Active & Passive building applications. Economics (IRR, LCOE,ROI)Design,modelingand simulationofsolarenergysystems.	22
	Totalhours	**42hours**

Text Books

- S.PSukhatmeandJ.KNayak.“Solarenergy,principleofthermalcollectionandstorage”
- S. Kalogirou “Solarenergyengineering:processesandsystems.”ISBN978-0-374501-9

ReferenceBooks:

- YogiGoswami“PrincipleofSolarengineering”, CRCPress,Thirdedition.
- J.ADuffie&W.ABeckman“Solarengineering&thermalprocesses”JohnWiley&Sons,4ed.
- G.NTiwari“Solarenergy:Fundamental,design,ModelingandApplications”ISBN-10:0849324092
- C.P.Arora“Refrigerationandairconditioning”TataMcgraw-Hill PublishingCompany,2ndEd.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

CO1.UnderstandworkingofsolarradiationmeasuringequipmentsCO

2.Determinemagnitude ofincidentradiation.

CO3. Understandworkingofsolarcollectorsystems.

CO4.Applyknowledgetodesignimprovedsolarenergybasedsystems.CO5.

Analyzeprocessesofspaceheating and coolingsystems.

CO6.
Canperformmodelingandsimulationforperformanceanalysistooptimizethesystemefficienc
y.

CO7.Designanddevelop smallsolar energybased systemssuitableforruralareas.

MappingofCourseOutcomes(COs) withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PSO1
CO2	PO4/PSO1
CO3	PO1,PSO1
CO4	PO3,PO5,PSO1,PSO2
CO5	PO7,PO9,PO3,PSO1,PSO3
CO6	PO3,PO4,PO5,PSO1,PSO3
CO7	PO3,PO6,PO7,PO10,PO12,PSO1,PSO3

BMEE0172SOLARENERGYLAB

Objective:*Todevelopthecapabilityofstudentstounderstandsolarenergyharvestingsystemsandto applyacquiredknowledgetofulfillthesocialneeds.*

Credits:01 **L–T–P-J:0–0–2-0**

Exp.No	Experimentobjective	Hours
1	TodeterminethermalefficiencyofFPSCinindoorcondition	2
2	TodeterminethermalefficiencyofFPSCinnaturalmode	2
3	Todeterminethermalefficiencyofsingleaxisparabolictrough collector	2
4	TodeterminethermalefficiencyofPTC (doubleaxis)	2
5	Determinethermalefficiencyofsolarairheatingsystem	2
6	Todeterminecharginganddischargingefficiencyofenergy storagesystem.	2
7	Todetermineoverallheat transfercoefficient ofenergystorage system.	2
8	Todetermineoverallheat transfercoefficient ofFPSC.	2
9	Tostudysolartrackingsysteminparabolictroughcollector	2
10	Toanalyzethethermalperformanceofheatpipeuseinsolar collectorsystem.	2
11	Tostudyworking ofPV/Tsystemforsolarenergyabsorption	2
12	Tostudyworkingofthermalimagingcameraand itsapplication	2

Text/Referencebooks:

- “Renewableenergypowerfor sustainablefuture”,oxforduniversitypress.
- S.PSukhatmeand J.KNayak “Solarenergy,principleofthermalcollectionand storage”
- S.Kalogirou“Solarenergyengineering:processesandsystems”ISBN978-0-374501-9

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

- CO1:Tounderstandworkingofsolar radiationmeasuringequipments.
- CO2:Determine magnitudeofincidentradiation.
- CO3:Analyzeperformanceofvarioussolar collectorsystems.
- CO4:Applytheirknowledgetodesignimprovedsolarenergybasedsystems.
- CO5:Designandanalysesworkingofspaceheatingandcoolingsystems.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO4,PO5,PSO1
CO4	PO3,PSO1
CO5	PO3/PSO1

BMEE0186 PROJECT BASED SOLAR ENERGY LAB

Credits:02 **L–T–P-J:0–0–0-8**

Objective: Totrainandguidestudents for modeling, designandfabricationofprojectsbasedonsolarenergyharvestingandapplicationsinruralandindustrialsector.

1. Roleofnanofluidasaheattransferfluidinthermalenergystorageusingphasechangematerials.(Like MWCNT)
2. Experimentalinvestigationonthermalperformanceofheatpipe.
3. Experimentalphotovoltaicthermaltrainingsystemdomestictype.
4. Thermal energy storage via parabolic trough collector in high melting pointtemp.PCM.(likefattyacids)
5. Designandfabricationofflatplatesolarcollectorand investigatetheoverallefficiency.
6. Designandfabricationofparabolictroughcollectorandinvestigatetheoverallefficiency.
7. Designandfabricationofsolarairheaterandanalysisonefficiency.
8. Determinetheperformanceofparabolictroughcollectorwithfixedparametersandproperinsulationofstoragetank.
9. Designandfabricationofsolardryerandinvestigateefficiency.
10. DesignandanalysisofPV/T Solarairspaceheatingsystem.

Textbooksandreferences:

Text/Referencebooks:

- “Renewableenergypowerforsustainablefuture”,oxforduniversitypress.
- S.PSukhatmeand J.KNayak “Solarenergy,principleofthermalcollectionandstorage”
- S.Kalogirou“Solar energyengineering:processesandsystems”ISBN978-0-374501-9

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

- CO1:Applyacquiredknowledgeindesignofbasic solarenergyapparatus.
- CO2:Applyknowledgeofbasicsciences,heatandmasstransfer,thermodynamicsinanalysisofsolarapparatus.
- CO3:Analyzeperformanceofvarioussolar collectorsystems.
- CO4:Applytheirknowledgetodesignimprovedsolarenergybasedsystems.
- CO5:Integrate/applysolarsystemsforapplicationsinspace heatingandcoolingrequirement.

- CO6:Providesolutionto ruralandurbanpeopleregardingenergysaving andutilization

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO4,PO5,PSO1
CO4	PO3,PSO1
CO5	PO3/PSO1
CO6	PO6/PSO1

BMEE-0009 INTRODUCTIONTOVEHICLEDYNAMICS

Typeofcourse: *Elective(MechanicalEngineering),Advanced/Applications(AutomobileEngineering)*

Pre–requisite: *KinematicsofMachines,DynamicsofMachinery(MechanicalEngineering),AutomobileSystem,Physics(AutomobileEngineering)*

Objective: *To understand the principle and performance of vehicle in various modes such as longitudinal,vertical and lateral directions. At the end of the course the student will be able to identify the various forces andloadsand performanceunderacceleration, rideand braking.*

Credits:04 **Semester VI** **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:**IntroductiontoVehicleDynamics,LongitudinalDynamics,VehicleLoadDistribution – Acceleration and Braking - Brake Force Distribution, Braking Efficiency.**Aerodynamics:**MechanicsofAirFlowAroundaVehicle,PressureDistributiononaVehicle,AerodynamicForces,DragComponents,AerodynamicsAids.**TireMechanics:**TireConstruction,SizeandLoadRating,TerminologyandAxisSystem,TractiveProperties,CorneringProperties,CamberThrust,AligningMoment,CombinedBraking andCornering,ConicityandPlySteer,Slip,Skid	25
II	**Tire Mechanics:** Rolling Resistance, Elastic Band Model for longitudinal slip, Simplemodel for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut stringmodel for lateral slip, Magic Tire Formula. **Motorcycle Dynamics:** Kinematic structureof motorcycle, geometry of motorcycles, importance of trail, Resistance forces acting onmotorcycle(tyrerollingresistance,aerodynamicresistanceforces,resistantforcecaused byslope),Location& heightofmotorcycle'scentreofgravity(C.G),Momentsof inertiaonMotorcycle.IntroductiontoFront&RearsuspensionsofMotorcycle	25

Text Books:

- WongJY,"TheoryofGroundVehicles",JohnWiley&Sons,NewYork,1978.
- MillikenWFandMillikenDL,RacecarVehicleDynamics,SAE.
- Garrett T K, Newton K and Steeds W, "Motor Vehicle", Butter Worths& Co., Publishers Ltd., NewDelhi, 2001.

Reference Books:

- R N Jazar, Vehicle Dynamics: Theory and Application, SpringerRogowsky, "*IC Engines*", InternationalBookCo.
- HansPacejka,TireandVehicleDynamics,Elsevier,2012.
- ThomasDGillespie,"FundamentalsofVehicledynamics",SAEUSA1992.
- RajeshRajamani,VehicleDynamics&control,Springer.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: *Attheendofthecourse,astudentwillbeableto*

CO1.*Understandthedynamicsofvehicleride.*

CO2.*Calculateandrefertheloadsandforcesassociatedtothevehicles.*

CO3.*Analysethebehaviorofthevehiclesunderacceleration,rideandbraking*

CO4.*Understandhowpassengercomfortisachievedalongwithvehiclestability.*

CO5.*Understandandexplaintheeffects ofResistanceforcesonthepowerofanautomobile.*

CO6.*Abilitytounderstandaboutsuspensionandtyrerelatedvibrations.*

MappingofCourseOutcomes (Cos)withProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	*POs/PSOs*
CO1	*PO1,PO2,PO3,PO4/PSO1*
CO2	*PO3,PO6,PO9,PO10/PSO1*
CO3	*PO2,PO3,PO4,PO6/PSO1*
CO4	*PO1,PO2,PO3,PO4,PO6,PO12/PSO1*
CO5	*PO1,PO3,PO6/PSO1*
CO6	*PO1,PO3,PO6,PO12/PSO1*

BMEE0173VEHICLEDYNAMICSLAB

Credits:01 **L–T–P-J:0–0–2-0**

- Experimentalstudyofmechanismforairflowoverdifferentgeometryofvehicles.
- Experimentalstudiesofmeasurementsofdragandliftcoefficientfordifferentgeometryvehicleusingwind tunnel apparatus.
- Tostudytheeffectoftyrepressure andtemperatureontheperformanceofthetyre.
- Tosimulateand studyaquartercarmodelsusingMBDsoftware.
- Tosimulateandunderstandbehaviourofsprung/un-sprungmass&lumpedmasssystemMBDsoftware.
- Findingthestiffnessoftyrewithvariationofairpressure.
- Tosimulateand studythe effectofdifferentconditionson vehicleloading.
- Studyoflatesttechnologiesavailablenowadaysinvehicleshelpingtomaintainstabilityof thevehicleontheroad.
- Studygeometryofmotorcyclesaswellasvarioustypesofforcesfacedbythemotorcycle &its rider
- Studythelocation&heightofCentreofgravity(C.G)ofamotorcycle

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome:

Attheendofthecourse,astudentwill beableto

CO1.Thestudentwill beabletodeterminetheeffectsofairflow overdifferentgeometryofvehicles. **(Apply)**

CO2.The student will be able to determine coefficient of drag and lift for different vehicle geometrybyusingwindtunnel apparatus.**(Analyze)**

CO3.The student will be able to understand quarter car models and Behaviour of sprung / un-sprungmass&lumpedmasssystem.**(Understand)**

CO4.The student will be able to understand geometry of motorcycles as well as various types offorcesfacedbythemotorcycle&its rider.**(Understand)**

CO5.The student will be able to understand geometry of motorcycle and various forces effect onvehicleanditsrider. **(Understand)**

CO6.TheStudentwill beable to locateandfindheightofCentreofgravity (C.G)ofamotorcycle. **(Analyze)**

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs) :

COs	***POs/PSOs***
CO1	***PO2,PO3,PO4,PO6/PSO1***
CO2	***PO3,PO6,PO9/PSO1***
CO3	***PO1,PO2,PO4,PO10/PSO1***
CO4	***PO1,PO2,PO4,PO10/PSO1***
CO5	***PO1,PO2, PO3,PO4,PO6,PO12/PSO1***
CO6	***PO3,PO4,PO6,PO9/PSO1***

BMEE0101:ADVANCEDFLUIDMECHANICS

Objective: *Aims to give Mechanical Engineering students a deeper and more thorough grounding in principlesand basic applications of fluid mechanics. Topics include: reviewof the conservation principles;constitutive relations of Newtonian fluid; Navier-Stokes equation; inviscid flow – inertial propertiesofvortex,2Dpotentialflows;viscousflow–basiclaminarflows,boundarylayertheories;introduction toturbulentflow –flow separation,sourcesofdrag.*

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Basic Concepts and Fundamentals:** Definition and properties of Fluids,Fluid as continuum, Langragian and Eulerian description, Velocity and stressfield, Fluidstatics,FluidKinematics **GoverningEquationofFluid Motion:**Reynoldstransporttheorem,Integral and differential forms of governing equations: mass, momentum andenergyconservationequations,Navier-Stokesequations,Euler'sequation,Bernoulli'sEquation. **Exact Solution of Navier – Stokes Equation:** Couette flows, Poiseuilleflows,Fullydevelopedflowsinnoncircularcross-sections,Unsteadyflows,Creepingflows. **Potential Flows:** Revisitof fluidkinematics,Stream andVelocitypotentialfunction, Circulation, Irrotational vortex, Basic plane potential flows: Uniformstream;SourceandSink;Vortexflow,Doublet,Superposition ofbasicplane potential flows, Flow past a circular cylinder, Magnus effect; Kutta-Joukowski lifttheorem;Conceptof liftanddrag.	20
II	**LaminarBoundaryLayer:**Boundarylayerequations,Boundarylayerthickness, Boundary layer on a flat plate, similarity solutions, Integral form ofboundarylayerequations,ApproximateMethods,Flowseparation,Entryflowintoa duct. **Turbulent Flow:** General equations of turbulent flow, Turbulent boundarylayer equation, Flat plate turbulent boundary layer, Turbulent pipe flow, Prandtlmixinghypothesis,Turbulencemodeling,Freeturbulentflows. **Compressible Flow:** Speed of sound and Mach number, Basic equations foronedimensionalflows,Isentropicrelations,Normal-shockwave,RankineHugoniotrelations,FannoandRayleighcurve,Machwaves,Obliqueshockwave, Prandtl-Meyerexpansionwaves,Quasionedimensionalflows,Compressibleviscousflows,Compressibleboundarylayers.	21

TextBooks:

- GuptaVijayandGuptaS.K.,"FluidMechanicsanditsApplications",WileyEasternLtd,1984.
- Som,S.K.&BiswasG.,"Introductionoffluidmechanics&FluidMachines",TMH,2000,2ndEdition
- Shames, I.H.,"MechanicsofFluids", McGrawHill, Int.Student,Education, 2016
- FrankM.White,ViscousFluidFlow,ThirdEdition,McGraw-HillSeriesofMechanicalEngineering,2006

ReferenceBooks:

- Fox W.Robert,McDonald T.Alan,Introduction toFluidMechanics,Fourth Edition,JohnWiley&Sons,1995
- MuralidharK.andBiswasG.,AdvancedEngineeringFluidMechanics,SecondEdition,Narosa,2005.
- SchlichtingH.,BoundaryLayerTheory,SpringerVerlag,2000.
- McCormack,P.S.&Crane,L.J.PhysicalFluidDynamics, AcademicPress,1973

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Onlearningthissubject,studentswillbeableto:*

- *CO1:Applythefundamentalsofkinematics,dynamicsandconservationlawsoffluidflowsystems.*
- *CO2:Apply theprinciplesofhighand lowReynoldsnumberflowstofluidflowsystems.*
- *CO3: Reviewtheconceptsofboundarylayerandflowin transition.*
- *CO4:Apply thefundamentalsofturbulentflowtovariousfluidflowsystems.*
- *CO5: Applythefundamentalsofonedimensional isentropicflowtovariablearea duct.*
- *CO6: Analysetheconcept of normal shockformation and itseffects.*
- *CO7:Applythe principlesofcompressible flowtoconstantareaductsubjectedtofrictionor heattransfer*

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2/PS1
CO4	PO1,PO2,PO3/PS1
CO5	PO1,PO2/PS1
CO6	PO1,PO2,PO12/PS1
CO7	PO1,PO2,PO12/PS1

BMEE-0102COMPRESSIBLEFLUIDFLOW

Prerequisites:*AdvancedFluidMechanics*

Objectives: *The objective of this course for post-graduation students is to provide a solid background onthepertinentmathematical,physical,andengineeringconceptsthatmakeupthefoundationsof thecompressible flows.*

Credits:04 **L-T-P:3:1:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**BriefReviewofFluidMechanicsandThermodynamics:**Introduction,Dynamics Lawsofmotion,Kinematics,Equationofmotion,Reviewofthermodynamics, concepts of entropy and vorticity, Ideal gases, Special formsof the governing equations, Transport properties. **Physical Acoustic & Natureof Steady Compressible Fluid Introduction,**Onedimensionwavemotion,Transportofenergy& momentum, propagation of sound in duct, Machnumber,InviscidEnergyequation,PotentialFlow,Isentropicflow.**OneDime nsional Steady Flow:** Introduction, Isentropic flow of perfect gases induct,Flowwithfriction,Flowwithheataddition,Flowwithfrictioninaconstantare a pipe.	25
II	**OneDimensionalUnsteadyFlow**:Shock conditions, the properties ofshock waves, weak & strong shockapproximation, Characteristicequationsfor homentropic &isentropicflow, Method of characteristics,piston analogy, Detonations and deflagrations. **Two Dimensional Steady Flow**Prandtl-Mayer function, Method of characteristics, Obliqueshocks,shockpolar,Reflectedandintersectingshocks,expansion waves,Curvedshocks,Nozzledesign,Linearizedpotentialflow,thinairfoilandslend erbodytheories,Conicalflow,Transonicflow.**ViscousEffects&AnalogsofCompr essibleFlow**:Compressibleboundarylayers,Shockthickness,Shockwave-boundarylayer interactions, Shallow water flow, Trafficflow, Electro-acousticalanalogy	25

TextBooks:

- *BalachandranP.,FundamentalsofCompressibleFluidDynamics,PHILearning.2006*
- *RathakrishnanE.,GasDynamics,PHILearning,2014*
- *YahyaS.M.,FundamentalsofCompressibleFlowwithAircraftandRocketPropulsion,NewAgeInternationalPublishers,2003*

ReferenceBooks:

- *Anderson,Moderncompressibleflow,3eMcGrawHillEducation,2012.*
- *Shapiro,DynamicsandThermodynamicsofCompressibleFlow –Vol1.,JohnWiley&Sons,1953*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome: ***Attheend ofthecourse, a studentwillbeableto***

CO1. *Formulate and solve problems in one -dimensional steady compressible flow including: isentropic nozzleflow, constant area flow with friction (Fanno flow) and constant area flow with heat transfer (Rayliegh flow)*.***(Analyze)***

CO2.*Derivetheconditionsforthechangeinpressure,densityandtemperatureforflowthroughanormalshock.* ***(Apply)***

CO3.*Determinethestrength ofobliqueshockwavesonwedgeshapedbodiesand concavecorners.* ***(Determine)***

CO4.*Understandthevariousmeasuringinstrumentsusedincompressibleflow.****(Understand)***

CO5.*Understandtheeffectofviscosity&analogyofcompressibilityon boundarylayerformation.****(Understand)***

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO5/PSO1
CO2	PO1,PO2,PO3/PSO1
CO3	PO2,PO3,PO3/PSO1
CO4	PO1,PO3,PO5/PSO1
CO5	PO1,PO3,PO5/PSO1

BMEE0103AERODYNAMICS

Objective:
Students will be able to understandthe determination of forces, moments considering the thermal effects (heattransfers)on the bodies moving in a fluid.They will also learn the movement of wings or use of the wind force, thiswayitrequiresthecalculationstobedonefortheaerodynamicheatingoftheflightvehiclesandthehydrodynamic forcesapplied onthesurfaceofthevehicle.

Credits:04 **Semester** **L–T–P:3–1–0**

ModuleNo.	Content	Teaching Hours
I	**Introduction:**Airfoils,wingsandtheirnomenclature;lift,dragandpitching momentcoefficients;centerofpressureandaerodynamiccenter. Potential flow Analysis; Scalar and vector fields, velocity potential, line,surfaceandvolumeintegrals,circulationandliftgeneration,Kutta-Joukovskii theorem. Methodofsuperposition,thinairfoiltheory,sourceandvortexmethods. **Subsonic Flow:**Subsonic compressible flow past airfoils; Critical Machnumber, drag divergence Mach number, supercritical airfoils, effect ofsweep,area rule.	20
II	Fullandperturbationvelocitypotentialformulations;PrandtlandGlauertc ompressibilitycorrections. Transonic flow past airfoils, transonic similarity rules; Supersonic flowpastairfoils, linearized supersonic flow. Potentialflowoverliftingwing,liftinglinetheory,vortexlatticemethod, slender body theory, variation of lift and drag coefficients insubsonic flows with angle of attack, Reynolds number, thickness-to-chordratio. Supersonic flow over airfoils and wings; subsonic/supersonic leadingedge Hypersonicflows,Newtoniantheory,liftanddraginhypersonicflows	20

Books/References:

- Anderson.JD,Jr.,FundamentalsofAerodynamics,McGrawHill2001.
- L.M.Milne/Thompson,TheoreticalAerodynamics.
- Houghton,E.L.andCarpenter,P.W.,AerodynamicsforEngineers,Butterworth-Heinemann,2001.

OnlineEducation:

- MITOpenCourseware:MuddyPointAerodynamics.
- www.edx.org:AerodynamicsCourses:Problems&Assignments.
- https://www.grc.nasa.gov/www/k-12/airplane/presar.html

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

CO1 *Aftercompletingthissubjectstudents willbeableto:*
CO2.Definephysicalcharacteristicsofairandatmosphere.
CO3. Define basic aerodynamic forces acting on an aircraft and the factors affecting aerodynamic forces.CO4.Definegeometriccharacteristicsofairfoiland wing.
CO5.Explaintheeffects ofcamber,angleofattackandthicknessontheaerodynamiccharacteristicsofanairfoil.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/ PSOs
CO1	PO1,PO3,PO5/ PSO1,PSO3
CO2	PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3
CO3	PO1,PO2,PO3,PO4/ PSO1,PSO2,PSO3
CO4	PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3
CO5	PO1,PO3,PO5/ PSO1,PSO2,PSO3

BMEE0104:TURBULENTFLOW

Pre-requisite:AdvancedFluidMechanics
Objective:*Toprovideageneralintroductiontothephysicsandmathematicaldescriptionofturbulence;Toi ntroducethemethodsofanalysisusedinturbulencestudy,Tounderstandtheprinciplesofturbulencesimulati onandmodeling.*

Credits:4 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction**:Propertiesoflaminarflow,Propertiesofturbulent flow, Boundary Layer, Growth rate of Boundary layerfor LaminarandTurbulentFlows. **Characteristics of Turbulent Flow**: The Origin of Turbulence,NatureofTurbulence,SwirlingStructure,MeanMotion andFluctuations,ConsequencesofTurbulence,Homogeneous-IsotropicTurbulence. **CorrelationFunctions&KolmogorovHypothesis**:CorrelationFunctions,Ideasabouteddysize,IntensityofTurbulenceorDegreeof Turbulence,KolmogorovUniversalLawfortheFineStructure,EnergyCascade,KolmogorovLengthScale,Kolmogorov'sFirstHypothesis,Kolmogorov'sSecondHypothesis. **Reynolds'AveragedNavier-StokesEquations:**FurtheronLawsofAveraging,Reynolds'Decomposition,ExamplesofTurbulentFluctuations,andSomeMeasurementsonFluctuatingComponents. **Measurements on Fluctuating Components**: Shear Stress duetotheFluctuations,TheboundarylayermeasurementsofKlebanoff.	19
II	**Turbulent Boundary Layer Equations**: Turbulent BoundaryLayer Equationsforatwodimensionalflow. **ClassicalIdealizationofTurbulentStresses**:Introduction,TheBoussinesqor eddyviscositymodel,Eddyviscosity. **Vorticity Dynamics**: Introduction, Vorticity and the equationsof motion, Reynolds stress and vorticity, Vortex Stretching. TheVorticityEquation,VorticityinTurbulent Flows. **Dynamics of Turbulence**: Kinetic Energy of the Mean Flow,KineticEnergyofFluctuations,SomeScaling Relations. **The Law of the Wall for Wall Bounded Flows**: The Law of theWallforWallBoundedFlows,TheUniversalVelocityProfile, FreeShearFlows,TurbulentJets,UniformEddyViscositymodel.	21

TextBooks:

RJ.Garde,*"TurbulentFlow"*NewAge International PvtLtdPublishers

ReferenceBooks:

- StephenB.Pope,"*TurbulentFlows*",CambridgeUniversityPress
- H.TennekesandJ.L.Lumley,*"AFirstCourseinTurbulence"*,MITPress

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*At theendof thiscoursestudentswill beableto*

CO1.Understandthecharacteristicsofturbulentflow. ***(Understand)***

*CO2.ExplaintheCorrelationFunctions&KolmogorovHypothesis.****(Understand)***

*CO3.UnderstandReynolds'AveragedNavier-StokesEquationsandTurbulentboundarylayerequation.****(Understand)***

*CO4. Understand measurementoffluctuatingcomponentsandturbulentstresses.****(Understand)***

*CO5.Understand VorticityandTurbulencedynamics.****(Understand)***

*CO6.Understandtheconceptofwallbounded flows.****(Understand)***

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	PSO/PO
CO1	PSO1/PO1/PO2
CO2	PSO1/PO1/PO2/PO3
CO3	PSO1/PO1/PO2/PO3
CO4	PSO1/PO1/PO2/PO3
CO5	PSO1/PO1/PO2
CO6	PSO1/PO1

BMEE0105:COMPUTATIONALFLUIDDYNAMICS

Objective: *TheobjectiveofCFDistomodelthe continuousfluidswithPartialDifferentialEquations(PDEs)anddiscretizePDEsintoanalgebraproblem(Taylorseries),solveit,validateitand achievesimulationbaseddesign.*

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** What is CFD, How Does A CFD Code Work, Applications of CFDandProblemSolvingWithCFD. Classification of Physical Behavior, The Role of Characteristics in HyperbolicEquations,ClassificationMethodforSimplePartialDifferentialEquation,Classification of Fluid Flow Equations, Auxiliary Conditions for Viscous FluidFlowEquation. **ConservationLawsofFluidMotionandBoundaryConditions:**Stresstensoroveracontrolvolume,EiensteinIndecies,KronwerDeltaConcept,GoverningEquationsofFluidFlow,EquationofState,Continuityequation in Cartesian coordinate, polar coordinate and spherical coordinatesystem,Navier – Stokes Equations for A Newtonian Fluid, Conservative Formof the Governing Equations for Fluid Flow, Differential and Integral Forms ofthe GeneralTransport Equation,Applicationsof NavierStokesequation ofmotion-Flowthroughpipe, flowbetweentwoparallelplatesetc. **TurbulentFlow:**Turbulence,typesofturbulence,continuityequationforturbulentflow.Navierstokesequationforturbulentflow.Reynoldsstresstensorfor turbulentflow **Turbulence and Its Modeling** Turbulence Models Such as Boussinesquemodel, Mixing Length Model, application of mixing length model, Von-Karmanturbulencemodel,applicationofVon-Karmanturbulencemodel,TheK–ƐModel,ReynoldsStressEquationModels.	20
II	**Potential Flow:** Source flow, Sink flow, Doublet, flow past a half body,flowovercylinder, pressure distribution. **The Finite Volume Method for Diffusion Problem:** Introduction, FiniteVolumeMethodforSteadyStateDiffusion,WorkedExamples:OneDimensionalSteadyStateDiffusion, **TheFiniteVolumeMethodforConvection–DiffusionProblem:**Introduction, Steady One Dimensional Convection and Diffusion, The CentralDifferencingScheme,PropertiesofDiscretisationScheme,TheUpwindDifferencingScheme,TheHybridDifferencingScheme,Propertiesof discretisationscheme.	20

TextBooks:

- AndersonJ.,"*ComputationalFluidDynamicsAnIntroduction*",IIIEdition,Springer,2009.

ReferenceBooks:

- ZikonavOleg,“*EssentialComputationalFluidDynamics*”,JohnWiley&Sons,2010.
- BlazekJ.,“*ComputationalFluidDynamics:PrinciplesandApplications*”,IIEdition,2009,ElsevierLtd.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: *Studentsareexpectedtolearn:*

CourseOutcomesOncompletionofthis course,thestudentswillbeableto

CO1. Understand the Mathematical application used in CFD tools and techniques for effective designs ofstructuredgrid.

CO2. Apply modeling techniques to all the fluid dynamics, solid dynamics problems with respect to Multi-Disciplinary Industry.

CO3. Classify various computational methods for grid generation and its importance of efficient grid.CO4.Formulateunstructuredgridusingvariousmethodsbyconsideringdifferentboundaryconditions CO 5.SimulatesimpleCFDmodelsand analyzeitsresults.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	*POs/PSOs*
CO1	*PO1,PO3,PO5/ PSO1,PSO3*
CO2	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO3	*PO1,PO2,PO3,PO4/ PSO1,PSO2,PSO3*
CO4	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO5	*PO1,PO3,PO5/ PSO1,PSO2,PSO3*

BMEO0002ENERGYCONSERVATIONANDMANAGEMENT

Objective: *The main objective of this course is to understand the principles associated with effective energymanagement and to apply these principles in the day-to-day life. To gain exposure to energy auditing, to identifyenergy conservation opportunities in various industrial processes and to evaluate the performance of boilers,furnacesandotherenergyintensiveequipment/processes.*

Credits:04 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **INTRODUCTION:** Principles of energy management. Managerial organization,Functionalareasfori)manufacturingindustry,ii)Processindustry,iii)Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating,Organizingandmanaging energymanagementprograms **ENERGY AUDIT:** Definition and concepts. Types of energy audits, Basic energyconcepts,Resourcesforplantenergystudies.Datagathering,Analyticaltechniques.**EnergyConservation:**Technologiesforenergyconservation,Designforconservationofenergymaterials,Energyflownetworks.Criticalassessmentof energy usage. Formulation of objectives and constrains, Synthesis of alternativeoptionsandtechnicalanalysisof options.Processintegration.	23
II	**Unit-II** **ENERGYEFFICIENCY:**FuelsandCombustion-Boilers-SteamSystem-Furnaces-InsulationandRefractory-FBCBoilers-Cogeneration-Wasteheatrecovery,DieselGeneratingSystem. **ENERGYPERFORMANCEASSESSMENT:**EquipmentandUtilitysystems-Boilers-Furnaces-Cogeneration, Turbines (Gas, Steam)- Heat Exchangers-ElectricMotors and Variable Speed, Drives-Fans and Blowers-Water Pumps-Compressors.**ALTERNATIVE ENERGY SOURCES:** Solar energy: Types of devices for solarenergycollections,Thermalstoragesystem,Controlsystems.WindEnergy, Availability,WindDevices,WindCharacteristics,performanceofturbinesandsystems. WasteMinimizationandResourceConservation.	22

TextBooks:

- H.KoontzandCyrillDonnel"Management" McGrawHill
- S.C.Kuchhal"FinancialManagement"ChaitanyaPublishingHouse.

ReferenceBooks:

- W. C., Turner and S. Doty "Energy Management Hand Book" FairmontPress, 2009, 7thedition.
- C.BSmith"EnergyManagementPrinciples"PergamonPress,2007
- W.RMurphy"EnergyManagement"Elsevier,2007.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

- *CO1:Understandingofenergyconservationand identificationofenergyconservation,opportunitiesinvariousindustrialprocesses.*
- *CO2:Knowledgeofvarioustoolsandcomponentsenergyauditing.*
- *CO3:Abilitytoevaluate theperformanceofindustrialboilers,furnacesetc.bydirectandindirectmethods.*
- *CO4:toinvestigatecogeneration inindustryandwasteheatrecoverytechniquesanddevices.*

- *CO5:Toconductenergyauditsindomesticandsmallindustries.*
- *CO6:Applyknowledgetodevelopmodelandprototypeswhichcanrecoverwasteheatforenergyefficiency.*

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PSO1
CO2	PO1,PO3,PSO1
CO3	PO4,PO5,PSO1
CO4	PO4,PO5,PSO1
CO5	PO4,PO5,PO6,PSO1
CO6	PO4,PO5,PO6,PO7,PSO1,PSO2

COURSE STRUCTURE

B.TECH.

MECHANICAL ENGINEERING

WITH SPECILIZATION IN

SMART MANUFACTURING

Under

Choice Based Credit System (CBCS)

S.No.	Department	Program Offered	Subject Area	Credits	Total Credits
1	ME	B.Tech. Mechanical Engineering with specialization in Smart Manufacturing	Humanities & Social Sciences, Soft Skill and EPP	25	186
			Basic Sciences	24	
			Engineering Sciences	30	
			Program Core	48	
			Program Electives	26	
			Open Electives	16	
			Project Work / Seminars	17	
			Non-Graded Mandatory Courses	0	

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication – I	2	0	0	2	2
4.	BECG0001	Electronics Engineering	3	1	0	4	4
5.	BMEG0900	Product Design & Development	5	0	0	5	5
PRACTICALS							
6.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1	2
7.	BELH0801	English Language Lab – I	0	0	2	1	2
8.	BECG0800	Electronics Lab I	0	0	2	1	2
9.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**23**	**31**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BEEG0001	Electrical Engineering	3	1	0	4	4
3.	BELH0002	English Language Skills for Communication – II	2	0	0	2	2
4.	BMEG0901	Product Design Manufacturing	4	0	0	5	5
5.	BPHS0001	Engineering Physics	3	1	2	5	6
6.	BCSC0001	C Programming	3	0	0	3	
7.	BMEG0002	Applied Mechanics	3	0	0	3	3
PRACTICALS							
7.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
8.	BELH0802	English Language Lab – II	0	0	2	1	2
9.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
10.	BCSC0800	C Programming/Python Lab	0	0	2	1	2
11	BMEG0802	Mechanics Lab	0	0	2	1	2
		TOTAL	**17**	**4**	**10**	**31**	**31**

ProgramCore

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
THEORY									
1	BMEC0001	MaterialScience	2	0	0	0	2	2	
2	BMEC0800	MaterialScience&TestingLab	0	0	2	0	1	2	
3	BMEC0002	AppliedThermodynamics	3	1	0	0	4	4	BasicMechanical
4	BMEC0003	Measurement&Metrology	2	0	0	0	2	2	-
5	BMEC0801	Measurement&Metrology Lab	0	0	2	0	1	2	
6	BMEC0004	Heat&MassTransfer	3	0	0	0	3	3	Applied
7	BMEC0802	Heat&MassTransferLab	0	0	2	0	1	2	
8	BMEC0005	FluidMechanics	3	0	0	0	3	3	Engineering
9	BMEC0803	FluidMechanicsLab	0	0	2	0	1	2	
10	BMEC0006	ManufacturingScienceI	3	0	0	0	3	3	MaterialScience
11	BMEC0804	ManufacturingScienceILab	0	0	2	0	1	2	
12	BMEC0007	StrengthofMaterial	3	0	0	0	3	3	AppliedMechanics
13	BMEC0008	KinematicsofMachines	3	0	0	0	3	3	AppliedMechanics
14	BMEC0009	DynamicsofMachine	3	0	0	0	3	3	KinematicsofMachines
15	BMEC0805	TheoryofMachineLab	0	0	2	0	1	2	
16	BMEC0010	MachineDesignI	3	0	0	0	3	3	StrengthofMaterial
17	BMEC0806	MachineDesignILab	0	0	2	0	1	2	
18	BMEC0011	MachineDesignII	3	0	0	0	3	3	MachineDesignI
19	BMEC0807	MachineDesignII Lab	0	0	2	0	1	2	
20	BMEC0012	FluidMachinery	3	0	0	0	3	3	FluidMechanics
21	BMEC0808	FluidMachineryLab	0	0	2	0	1	2	
22	BMEC0013	ManufacturingScienceII	3	0	0	0	3	3	ManufacturingScienceI
23	BMEC0809	ManufacturingScienceIILab	0	0	2	0	1	2	
24	BMEC0014	ModernVehicleTechnology	3	1	0	0	4	4	
25	BMEC0015	AdvanceMaterialScience	3	0	0	0	3	3	

Program Elective

S. NO.	CODE	SUBJECT	TEACHINGSCHEME				CREDITS	CONTACT SHR/W	PRE-REQUISITES
			L	T	P	J			
THEORY									
1	BMEE0001	Refrigeration & Air-Conditioning	3	0	0	0	3	3	AppliedThermodynamics
2	BMEE0170	Refrigeration & Air-ConditioningLab	0	0	2	0	1	2	
3	BMEE0002	InternalCombustionEngine	3	0	0	0	3	3	AppliedThermodynamics
4	BMEE0003	AutomobileEngineering	3	0	0	0	3	3	Internal CombustionEngine
5	BMEE0171	AutomobileEngineeringLab	0	0	2	0	1	2	
6	BMEE0004	PowerPlantEngineering	3	0	0	0	3	3	AppliedThermodynamics
7	BMEE0005	GasDynamics	3	1	0	0	4	4	AppliedThermodynamics
8	BMEE0006	GasTurbineandJetPropulsion	3	1	0	0	4	4	AppliedThermodynamics
9	BMEE0007	AdvancedHeatTransfer	3	0	0	0	3	3	HeatTransfer
10	BMEE0008	SolarEnergy	3	0	0	0	3	3	AppliedThermodynamics
11	BMEE0172	SolarEnergyLab	0	0	2	0	1	2	
12	BMEE0186	ProjectbasedSolarEnergyLab	0	0	0	8	2	8	
13	BMEE0009	IntroductiontoVehicleDynamics	3	0	0	0	3	4	Automobileengineering
14	BMEE0173	VehicleDynamicsLab	0	0	2	0	1	2	
15	BMEE0101	AdvancedFluidMechanics	3	1	0	0	4	4	FluidMechanics
16	BMEE0102	CompressibleFluidFlow	3	1	0	0	4	4	Advanced FluidMechanics
17	BMEE0103	Aerodynamics	3	0	0	0	3	3	Advanced FluidMechanics
18	BMEE0104	TurbulentFlow	3	1	0		4	4	Advanced FluidMechanics
19	BMEE0105	ComputationalFluidDynamics	3	0	0	0	3	3	Numerical Methods&TurbulentFlow
20	BMEE0175	CFDLab	0	0	2	0	1	2	
21	BMEE0184	MachineDrawingLab	0	0	2	0	1	2	

22	BMEE0201	ComputerAidedDesign	3	0	0	0	3	3	MachineDesignII
23	BMEE0176	AdvancedSoftwareLab	0	0	2	0	1	2	
24	BMEE0202	ContunuumMechanics	3	1	0	0	4	4	StrengthofMaterial
25	BMEE0203	FiniteElementMethods	3	1	0	0	4	4	Continuu mMechani cs
26	BMEE0204	VibrationandNoise	3	1	0	0	4	4	DynamicsofMachine
27	BMEE0205	MachineToolDesign	3	0	0	0	3	3	MachineDesignII& ManufacturingSc.
28	BMEE0301	Computer AidedManufact uring	3	0	0	0	3	3	Manufacturin gScienceII
29	BMEE0178	CAD/CAMLab	0	0	2	0	1	2	
30	BMEE0192	ProjectbasedCAD/CAMLab	0	0	0	8	2	8	
31	BMEE0302	WeldingScience&Technology	3	0	0	0	3	3	Manufacturin gScienceI
32	BMEE0185	WeldingScience&Technology Lab	0	0	2	0	1	2	
33	BMEE0303	CompositeMaterials	3	0	0	0	3	3	MaterialScience
34	BMEE0304	Modern ManufacturingProcess	3	0	0	0	3	3	Manufacturin gScienceII
35	BMEE0179	Modern ManufacturingProcess Lab	0	0	2	0	1	2	
36	BMEE0193	Project based ModernManufacturingPr ocessLab	0	0	0	8	2	8	
37	BMEE0305	MetalForming Analysis	3	0	0	0	3	3	Manufacturin gScienceI
38	BMEE0401	IndustrialEngineering	3	0	0	0	3	3	
39	BMEE0402	Product Development &Design	3	0	0	0	3	3	MachineDesignII
40	BMEE0403	OperationsResearch	3	0	0	0	3	3	IndustrialE ngineering
41	BMEE0404	ValueEngineering	3	0	0	0	3	3	IndustrialE ngineering
42	BMEE0405	SupplyChainManagement	3	0	0	0	3	3	IndustrialE ngineering
43	BMEE0406	AppliedErgonomics	3	0	0	0	3	3	ProductDevelop ment& Design
44	BMEE0501	Robotics&FMS	3	0	0	0	3	3	IndustrialE ngineering

45	BMEE0182	Robotics&FMSLab	0	0	2	0	1	2	
46	BMEE0196	ProjectbasedRobotics&FMS Lab	0	0	0	8	2	4	
47	BMEE0502	IndustrialAutomation &ControlSystem	3	0	0	0	3	3	IndustrialE ngineering
48	BMEE0503	EngineeringSystemMo deling&Simulation	3	0	0	0	3	3	IndustrialE ngineering
49	BMEO0001	TotalQualityManagem ent	3	1	0	0	4	4	-
50	BMEO0002	EnergyConservation& Management	3	1	0	0	4	4	-
51	BMEO0003	SmartMaterials	3	1	0	0	4	4	-
52	BMEO0004	ProjectManagement	3	1	0	0	4	4	-
53	BMEO0005	ReliabilityandMainten anceEngineering	3	1	0	0	4	4	-
54	BMEO0006	Mechatronics	3	1	0	0	4	4	
55	BMEO0007	SixSigma&Application s	3	1	0	0	4	4	
56	BMEE0900	Product Design & Development	4	0	0	0	4	4	
57	BMEE0901	Product Design & Manufacturing	4	0	0	0	4	4	
58	BMEE0902	Injection Mold Design - 1	4	0	0	0	4	4	
59	BMEE0903	Injection Mold Design - 2	4	0	0	0	4	4	
60	BMEE0904	Press Tool Design	4	0	0	0	4	4	
61	BMEE0905	Press Tool Manufacturing	4	0	0	0	4	4	
62	BMEE0906	Smart Manufacturing	4	0	0	0	4	4	

BMEG0001:BASICMECHANICALENGINEERING

Objective: Precisethermodynamicseducationisarequirementtodiscussissuesthatonefacesint hermodynamics and resulting studiesin global warming, energy conversion and other energy related topicsthat affect sustainability of the environment in the global sense. Also introduce the students to various basicmanufacturingprocessescarriedoutinvariousindustriesverycommonly.

Credits:04 **SemesterI/II** **L–T–P:3–1–0**

Module No.	Content	TeachingHours
I	**Fundamentals of Thermal Engineering:** Thermodynamic systems, State &properties, Thermodynamic equilibrium & processes, Heat & work, Workdone for different polytrophic processes, Zeroth law of thermodynamics andits applications, First law of thermodynamics, Steady flow energy equation,Applicationoffirstlawtovariousthermodynamicsystemsanditslimitations. **Second Law of Thermodynamics:** Concept of heat engine, heat pump &refrigerator,SecondLawofThermodynamics,CarnotCycle,Carnottheorem.	20
II	**ConceptofEntropy:**ClausiusInequality,Conceptofentropy,Entropychangeduringvarious processes. **Steam & its Properties:** Definition of pure substance, Phase change, p-Tdiagram and pV-T surfaces, Formation of Steam, Concept and determinationof dryness fraction of steam, Thermodynamic properties of steam, SteamtableandMollier diagram. **Introduction to Manufacturing Processes**: Mechanical properties ofmaterials, Engineering Materials: Plain carbon steel and its applications**Casting Process:**Patterns and typesof patterns andtheir allowances,Moulding sandanditsproperties,Elements of gating system. **Fabricationprocesses:**Introductionandclassificationofwelding,principleand applications ofShieldedMetalArcWelding andGas Welding.	20

TextBooks:

- YadavR.:“*ThermodynamicsandHeatEngines*”:VolI&II (SlEdition)CentralPublishingHouseAllahabad, 2010.
- KumarD.S:“ThermalScienceandEngineering”:S.KKatariaandSons,Delhi,2004.

ReferenceBooks:

- NagP.K.:“*EngineeringThermodynamics*”:TMH,2017.
- Yadav R.: “*Thermodynamics and Heat Engines*” : Vol I & II (Sl Edition) Central Publishing HouseAllahabad, 2010.
- HajraChowdharySKandHajraChowdharyAK.“*WorkshopTechnology*”:MediaPromotors&Publishers,2010.
- RaghuwanshiRS,“*WorkshopTechnology*”:DhanpatRaiandSons,NewDelhi,2012.
- WarkWenneth:“*Thermodynamics*”:McGrawHillbookCo.NY,2015.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheendofthecoursethestudentwillbeableto:

- *CO1:Understandthebasiclawsofthermodynamicsandtheirapplicationsinrealworld.*
- *CO2: Calculateheatand energy transfer occur in atmosphereand incomponents under thermalengineeringapplications.*
- *CO3:Interpretthebehaviorofsteamanditsapplicationsinthermalengineering.*
- *CO4:Acknowledgetheapplicationofthermalengineeringassociatedwithhumanbody.*
- *CO5:Understandthebasic industrial processes of metal joining,fabrication &castingwithapplicationsinrealworld.*
- *CO6:Developbasicknow howandawarenessofvariousmanufacturingprocesses.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO7,PO6/PSO1
CO2	PO1,PO6,PO7/PSO1
CO3	PO1,PO7/PSO1
CO4	PO1/PSO1
CO5	PO1,PO5/PSO2
CO6	PO1,PO5/PSO2

BMEG0002APPLIEDMECHANICS

Objective: Theaimoftheappliedmechanicsistoteachthe basicanalyticalmethodsthatisthefundamentalconceptsandtechniquesofengineeringmechanics.

- *To givestudentspracticeinapplyingtheirknowledgeofmathematics,science,and engineeringandtoexpandthisknowledgeinto thevastarea ofAppliedMechanics.*
- *Toenhancestudents'abilitytodesignbyrequiringthesolutionofopenendedproblems.*
- *Topreparethestudentsforhigherlevel coursessuchascourses in MechanicsofSolids,MechanicalDesignandStructuralAnalysis.*

Credits:04 **SemesterI/II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:-** Mechanics:IdealizationofBodies,conceptofRigidBodies,ExternalForces,Moment andCouple,LawsofMechanics. **ForceSystemsAndEquilibrium:-** FundamentalConceptsandprinciplesofMechanics.Reductionofasystemofforcestoaforcecouplesystem**,**Concurrentforcesinaplane,FreeBodyDiagrams,Equations of equilibrium and their applications to various systems offorces. **Friction: - Friction forces and laws of dry friction,** Types of frictionandtheir applicationstoladderandbelt-pulleysystems **DistributedForcesandMomentOfInertia:-**BasicconceptsofCentroid, Area Moment of Inertia, Polar Moment of Inertia, Product ofinertia,Principalaxes,Parallelaxistheorem,Perpendicularaxistheoremandtheirapplicationsin Compositefigures.	22
II	**Beams:-**IntroductionofaBeamandits types**,**Conceptofbendingmoment and shear forces in beams, Shear Force and Bending MomentDiagramsfordifferentloadingconditions(pointload,uniformlydistributedload,uniformlyvaryingloadandcouple). **AnalysisofPlaneTrusses:-** Engineeringstructures,PerfectTruss,Determination of axial forces in the members, Method of Joints, MethodofSections. **KinematicsandKineticsofRigidBodies:-**Plainmotionofrigidbodies, Velocity and acceleration under translation and rotation, Work,PowerandEnergy, Impulseand Momentum,D'Alembert'sPrincipleand Lawof conservationofenergy.	23

TextBooks:

- Tayal,A.K.EngineeringMechanics:Statics&Dynamics,14thEdition(2011),UmeshPublications,Delhi
- V.S.Mokashi,EngineeringMechanics:StaticsVol.I&DynamicsVol-II,(TataMcGraw-Hill),NewDelhi

ReferenceBooks:

- Shames,I.H(1996),EngineeringMechanics,StaticsandDynamics4thedition,PrenticeHallofIndiaPvt.Ltd.,NewDelhi(EEE)
- F.P.Beer&E.R.Johnstonet.al.,VectorMechanicsforEngineers:StaticsandDynamics,12thEdition(2019)TMHNewDelhi

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheend ofthecoursethestudentwillbeableto:

- *Understandtherepresentationandanalysisofforces,moments,andequilibriumofparticlesandrigidbodies,Conc eptand principlesofworkand energy.*
- *Theeffectoffrictionanditsroleinengineeringapplications.*
- *Developbasicknowhowand awarenessto dealwith reallifeapplicationsinvarious fieldsofengineering.*
- *Determine internal actions in statically determinate structures and draw internal action diagrams –Shear Force(SFD)and Bending MomentDiagrams(BMD)forthesestructures.*
- *Identifyanappropriatestructuralsystemtostudyagivenproblemandisolateitfromitsenvironment*
- *Developconceptsofrigidbody kinematicsanddynamicswith anemphasisonthemodeling,analysis,andsimulation ofhowforcesproducemotionofrigid bodysystems.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2/PSO1
CO4	PO1,PO2/PSO1
CO5	PO1,PO2/PSO1
CO6	PO1,PO2/PSO1
CO7	PO1,PO2/PSO1
CO8	PO1,PO2/PSO1

BMEG0800:ENGINEERINGWORKSHOPPRACTICELAB

Objective: The purpose of this lab is to enable the students to have the practical skills for basic manufacturing processes and to study the various tools & equipment used e.g. Machining, Surface finishing, Welding, Casting,Drawings (Developments), Measuring instruments. The student will also have practical exposure with varioussafetyprecautionsindifferentsectionsoftheshops.

Credits:01 **L–T–P-J:0–0–2-**

Modul eNo.	Conten t	Lab Hour s

I	**ListofExperiments** **MachineShop:** **(1)** Tostudytheworkingofbasicmachinetoolslike Lathem/c,andDrillingm/c. **(2)** ToperformthefollowingoperationsonCentreLathe: **(i)** Centering,Facing,Turning,Stepturning,Taperturning. **(ii)** Knurling,Grooving,Chamfering,and Threading. **WeldingShop:** **(1)** ToprepareLapjoint,Buttjoint,T-jointbyusinganElectricArcwelding. **(2)** ToprepareLapjoint,Buttjoint,T-jointbyusinganOxy-Acetylenegaswelding. **CarpentryShop:** **(1)** To performdifferentoperationsin Carpentryshop such ascutting,planningandchiselingonthegivenwoodenpiece. **(2)** TopreparaeajointLapjoint,T-Joint,Dovetailjointbyusingwoodenspecimen/piece. **FoundryShop:** **(1)** To prepareaSandmouldforsolidcastingwiththehelpsinglepiecepattern&splitpattern. **(2)** Topreparethemouldforhollowcasting withthehelpofpatternand core. **SheetMetalShop:** **(1)** Todeveloptheblankdimensions forthegivenproductusingdevelopmentprocess. **(2)** TopreparaeaFunnelofrequireddimensionsusingjoiningprocesses. **FittingShop:** **(1)** To performtheoperationsofMarking,FilingandSawingonthe givenmetallicwork-piece(M.S.)as pergivendimensions. **(2)** Toperformtheoperationsofdrillingofmakingtheholesonthegivenmetallicwork-piece(M.S.)byuseofDrillingmachine. **(3)** Toperformtheoperationsofmakinginternalthreadsbyuseoftapesanddies.	30

Text/Reference Books:

- *JohnK.C.,“MechanicalWorkshopPractice”:PHILearningPvt.Ltd.,NewDelhi,2010.*
- *ChoudharyHajra,“ElementsofWorkshopTechnology”:MediaPromoters&PublishersPvt.Ltd.,Mumbai ,2010*
- *ChapmanW.A.J.,“WorkshopTechnology”,CBSPublishers&Distributors,NewDelhi,2007*

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Onsuccessfulcompletionofthislab,thestudentswillbeableto:

- *CO1:Demonstrateanunderstandingofandcomplywithworkshopsafetyregulations.*
- *CO2:Selectandperformarangeofmachiningoperationslike:turning,facing,knurlingdrilling,grindingetc.toproduceagivenjob.*
- *CO3:Acquirebasicknowledgeofwelding,jointdesignsuchasLapjoint,LapT-*

joint,Edgejoint,ButtjointandCornerjointandtheapplicationofwelding.

- *CO4:Abilitytodesignandmodeldifferentprototypesinthecarpentrytradesuchas Crosslapjoint,Dovetailjoint.*
- *CO5:Abilitytodesignandmodelvariousbasicprototypesinthetradeoffittingsuchas Straightfit,V-fit.*
- *CO6:Abilitytomakevariousbasicprototypesinthetradeof Tinsmithysuchasrectangulartray,andopenCylind er.*
- *CO7:Studentwillabletodesignmouldwiththehelpofgreensandmould.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1
CO2	PO1,PO3/PSO1
CO3	PO1,PO3/PSO1
CO4	PO3/PSO1
CO5	PO3/PSO1
CO6	PO3/PSO1
CO7	PO3/PSO1

BMEG0801ENGINEERINGDRAWING

Objective: Technical drawing is the language of engineering. The objective of this course is to learn initially thebasic principles involved in the projection of points, lines, lamina and solids. As well this course isfocusedtowards the interpenetration of solids, development of surfaces, isometric drawings and some basics of computeraided drafting software. It is expected that a student should learn this subject in a verysystematicway todeveloptheskilltoexpresseffectivelyhis/herideaaboutanobjecttoothersthroughdrawings.

Credits:01 **Semester I/II** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**Introduction** Drawinginstrumentsandtheiruses,BISconventions,letteringdimensioningand freehandpracticing (2 Drawing sheets)**Geometricconstruction&engineering Scales** Basicgeometricconstruction-Dividingagivenstraightlineintoanynumber of equal parts, drawing a regular polygon given one side, conicsections – ellipse – parabola. Concepts of scales –Plain, Diagonal & scaleofchord.(2Drawingsheets) **Orthographicprojection** Introductiontoprojection&orthographicProjections *Projectionsofpoints*lyinginfourquadrants *Projectionoflines*-parallelandinclinedtooneorbothplanes *Projectionofplanes*-inclinedtooneorbothplanes. *Projectionsofsolids*- axisperpendiculartoHP,axisperpendiculartoVPandaxis inclinedtooneorbothplanes. (4 Drawing sheets)**Sectioning of solids-** Section planes perpendicular to one plane andparallelorinclined tootherplane. (1Drawingsheets)**Development of surfaces-** Development of prisms, pyramids andcylindrical&conicalsurfaces (1Drawingsheets)**Isometric projection -**Isometric projection and isometric views ofdifferentplanesandsimplesolids (1Drawing sheets) **Computeraideddrafting**Introductiontocomputeraideddraftingpackageto make2-Ddrawings.	24

Text Books:

- Venugopal,K.andPrabhuRaja,V.:'EngineeringDrawingandGraphics+AutoCAD':NewAgeInternational,2017.
- Agrawal&Agrawal,C.:'EngineeringDrawing':TataMcGrawHill,2014.

Reference Books:

- Bhatt,N.D.andPanchal,V.M.,'EngineeringDrawing':CharotarPublishingHouse,2010.
- Natarajan,K.V.,'AtextbookofEngineeringGraphics':DhanalakshmiPublishers,Chennai,2014.
- Venugopal,K.andPrabhuRaja,V.,'EngineeringDrawingandGraphics+AutoCAD':NewAgeInternational,2017.
- Jolhe,D.A.,'Engineeringdrawing':TataMcGrawHill,2010.
- TrymbakaMurthy,S.,'ComputerAidedEngineeringDrawing':I.K.InternationalPublishingHouse,2008.
- Agrawal&Agrawal,C.,'EngineeringDrawing':TataMcGrawHill,2014.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcomes: *Attheendofthecoursethestudentwillbeableto*

- *CO1:Knowandunderstandtheconventionsandthemethodsofengineeringdrawing.*
- *CO2:Interpretengineeringdrawingsusingfundamentaltechnicalmathematics.*
- *CO3:Improvetheirvisualizationskillsso thattheycanapplytheseskillsindevelopingnewproducts.*
- *CO4:Improvetheirtechnicalcommunicationskillintheformofcommunicativedrawings.*
- *CO5:Comprehendthetheoryofprojection,Interpretviewsandsectionalviewsandprojections.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO3/PSO1
CO4	PO10/PSO1
CO5	PO3/PSO1

BMEG0802 APPLIEDMECHANICSLAB

Objective: *Thiscourseintroducesthefundamentalsofstaticsinengineering,whicharepreprerequisites for further study of advanced mechanics. The main objective of the course is tolearn basic principles of static in mechanics analyses, such as rigid bodies, friction between twosurfaces, centroid, reaction of beam, Newton's laws of motion and analysis of truss. It alsoincludesarangeofessential stepsforsolving problemsinstatics..*

Credits:01 **SemesterVI** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
1	**ListofExperiments:** **1.** Studyoffunctioningofgeartrains. **2.** Tofindthemechanicaladvantages,velocityratioande fficiencyofwormandwormwheel. **3.** Tofindthecoefficientoffrictionbetweenthesurfaceofagi venwoodslidebarandaninclinedplane. **4.** Tofindcentreofgravityofdifferentgeometricalobjects. **5.** Deflectionofsimplysupportedbeamandverificationoft heoreticalvalues. **6.** Tofindreactionatthesupportsofasimplysupportedbeamw ithdifferent typesofloading. **7.** Todeterminethemodulusofrigidityofrodwiththehelpofto rsiontestingmachine. **8.** Tostudyfunctioningofbeltpulleysystems. **9.** Tofindmomentofinertiaofaflywheelabouttheaxisofrot ationusing electroniccountermachine. **10.** Tofindforcesinmembersofatrussfordifferentload conditions.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheendofthecoursethestudentwillbeable

- ✓ *To knowthepractical skillstoanalyzetheforces,moments,andtheirequilibrium.*
- ✓ *Toknowthepracticalskillsto analyzetheeffectoffriction.*
- ✓ *Todevelop basic,knowhowandawarenesstodealwithpracticalaspectsofappliedmechanics.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO1
CO2	PO1,PO2/PSO1
CO3	PO1,PO2/PSO1

BMEG0803COMPUTERAIDEDDRAFTINGLAB

Objective:_Theobjectiveofthiscourseistoteachusersthebasiccommandsandtoolsnecessaryforprofessional2D drawing,design anddraftingusingAutoCAD._

Credits:01 **SemesterI/II** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**GettingStart–** Startingwithautocad,openandsavefiles,toolbars,screenlayouts. **BasicDrawing&EditingCommands-** DrawingLines,rectangles,Circles,viewingDrawing,Undo&Redocommands,Erasingobjectsetc. **DrawingPrecision-** UsingObjectsnap,Osnapoverrides,Polartrackingsettings,DrawingwithSNAP&GRID,function keys. **ChangesinDrawings-** Selectingobjectforediting,Movingobjects,copying,Rotatingobject,Scaling,mirroringeditingwithGrips. **DrawingOrganization&InformationLayers** Templates,Layers,LayerState,changingobjectlayers,etc. **AdvanceEditingCommands-** Trimming & extending, Stretching, Creating Fillets and Chamfers,Offset,creatingarraysofobjects. **Blocks** InsertionofBlockfromtoolPalettes,usinginsert,withdesigncentre. **Annotation-** Text,Hatching,Dimensions **3DModeling-** Introduction, basic tools, 3D navigation tools, UCS.Formationofsimplesolids,solidprimitives,meshmodel. **Creatingsolid**from 2D–Extrude,Swept,revolvesolid,loftedsolid. **EditingSolid**-Editingfacesofsolid,Filletandchamfer onsolids 2dviewfrom 3d.Multipleviewports	24

Text Books:-

- TrymbakaMurthy,S.,‘ComputerAidedEngineeringDrawing’,Pub-I.K.InternationalPublishingHouse.
- Venugopal,K.and Prabhu Raja,V.,‘EngineeringDrawingand Graphics+AutoCAD’,Pub-NewAgeInternational

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletingthiscoursethestudentwillbeableto:

- *CO1*:UseAutoCADfordailyprocesses requiringdesigninganddrafting.
- *CO2*:NavigatethroughoutAutoCADusingmajornavigatingtools.
- *CO3*:Understandtheconceptandtechniquestodrawtypicalgeometries.
- *CO4*:Createmultipledesignsusingseveraltools.
- *CO5*:Createlayerstocontroltheobjects'visibility.
- *CO6*:Explaindrawingusingannotations.

MappingofCourseOutcomes(Cos)withProgrammeOutcomes(Pos)andProgrammeSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO5,PO9/PSO1
CO2	PO3,PO4,PO5/PSO3
CO3	PO1,PO2,PO3/PSO3
CO4	PO1,PO2,PO5/PSO1
CO5	PO1,PO3,PO10/PSO3
CO6	PO1,PO5,PO10/PSO3

BMEC0011 MATERIAL SCIENCE

Objective: *To introduce the fundamentals of biomaterials, nanomaterials, ceramics, metals, polymers,electronic materials and composites, smart materials, green and sustainable materials emphasizingthe relationships between atomic structure and microstructure as well as the properties, processingandperformanceofthematerialinacohesiveandself-containedwaywithinthecourse.*

Credits:02 **L–T–P:2–0–0**

Module No.	Content	Teaching Hours
I	**CrystallographyandImperfections:**ConceptofUnitCellSpaceLattice,Bravais-Lattices,AtomicPackingFactorandDensitycalculations,Millerindices,ImperfectionsandDislocationsinSolids. **Introduction to Non Destructive Testing:** Liquid penetrant Testing,MagneticParticleTesting,UltrasonicTesting,EddycurrentTesting, Radiography,X-RayCrystallography. **Fatigue**: Stress cycles, Factors affecting fatigue, application of fracturemechanics to fatigue crackpropagation, **Creep:**Creepcurve,stagesincreepcurveandexplanation,creepmechanisms,metallurgicalfactors affectingcreep. **StrengtheningMechanism:**ConceptofGrainandGrainBoundary,Hall-Petchstrengthening,Solidsolutionstrengthening,precipitationstrengtheninganddispersionstrengthening.	22
II	**Equilibrium Diagrams:** Types of Equilibrium-Diagrams: Solid-SolutionType, Eutectic Type and Combination Type. Iron-Carbon Equilibrium-Diagram andItsImportance. **Heat Treatment:** Various Types of Heat Treatment Such As Annealing,Normalizing,Quenching,TemperingandCaseHardening.TimeTemperatureTransformation(TTT)Diagrams. **CorrosionScience:**Definitionandimportance,Electrochemicalreactions, Polarization, Passivity, Environmental effects, Eight forms ofcorrosion, **Prevention and control of corrosion:** Cathodic protection,Coatings andinhibitors. **PropertiesandApplication:**ConceptofMagnetismandMagneticmaterials,Ceramics,Superconductorsanditstypesandphenomenonof Superconductivity, Metallic foams, Polymers, Composites, Carbon fibre,Graphene,NanoMaterials, SmartMaterials.	22

Text Books:

- GuptaK.M.,"*MaterialsScience*",UmeshPublication.
- RaghvanV.,"*MaterialScience*",PrenticeHall.
- Narula,"*MaterialScience*",TMH.
- Fontana,M.G.,"*CorrosionEngineering",*TataMcGraw-Hill.

Reference Books:

- CallisterW.D.,JR,“*MaterialScience&Engineering*”,Addition-WesleyPublication.
- VlackVan,“*ElementsofMaterialScience&Engineering*”,JohnWiley&Sons.
- Avner“IntroductiontoPhysicalMetallurgy”TMHPub

CO1:Understandingofthecorrelationbetweentheinternalstructureofmaterials,theirmechanicalprop ertiesand

CO2:Understandingofvariousmethodstoquantifytheir mechanicalintegrityandfailurecriteria

CO3:Understandingof detailed interpretationofequilibrium phasediagrams.
CO4:BasicUnderstandingofdifferentphasesandheattreatmentmethodstotailorthepropertiesof Fe-C alloys

CO5: Knowledge of various alloying elements, their properties and applications.CO6:knowledgeof smart materials andtheiruniqueapplications

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PO3/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEC0800: MATERIAL SCIENCE AND TESTING LAB

Objective: To introduce the microstructure of solids in reference to solids viewed at the subatomic (electronic)and atomic levels, and the nature of the defects at these levels. The microstructure of solids at various levels profoundly influences the mechanical, electronic, chemical, and biological propertiesofsolids.Thephenomenological and mechanistic relationships between microstructure and the macroscopic properties ofsolidsare, inessence, what materialsscienceisallabout.

Credits:01 **L–T–P:0–0–2**

ModuleNo.	Content	Teaching Hours
I	**ListofExperiments** • ToPrepareSpecimenforMicroStructuralExamination-Cutting,Grinding, Polishing,Etching. • ToStudyCrystalStructuresandCrystalsImperfectionsUsingBallModels. • ToStudyBravaisLattice withHelpofModels. • ToDeterminetheGrainSize ofAGivenSpecimen. • Make A Comparative Study of Microstructures of Different GivenSpecimens after Micro Structural Examination (Mild Steel, Gray C.I.,Brass,CopperEtc.) • HeatTreatmentExperimentsSuchAsAnnealing,Normalizing,Quenching,CaseHardeningandComparisonofHardnessbeforeandAfter. • ToDeterminetheStrengthByTestingofAGivenMildSteelSpecimenonUTM WithFullDetailsand PlotontheMachine.	12
II	• ToConductShearandBend TestsonUTM. • To Conduct Impact Testing on Impact Testing Machine Like Charpy,Izodor Both. • ToConductHardnessTestingofGivenSpecimenUsingRockwellandVickers/Brinell TestingMachines. • ToCalculatetheDeflectionofBeamandYoung'sModulusofElasticityofaMaterialofaBeamSimplySupportedat theEnds. • ToConductTorsionTestingofARodonTorsionTestingMachine. • ToDeterminetheSpringIndexTestingonSpringTestingMachine. • ToPlotACurveBetweenStrainVsTime(E-T)forCreepTestingonCreepTestingMachine. • StudytheMicrostructureofWeldedComponentandHAZ(HeatAffected Zone)MacroandMicroExamination.	12

Text Books:

1. W.D.Callister,2006,"MaterialsScienceandEngineering-AnIntroduction",6thEditionWileyIndia.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall ofIndiaPrivateLimited, 4thIndian Reprint, 2002.

Reference Books:

1. Raghavan,“MaterialScienceandEngineering’,PrenticeHallofIndiaPrivateLimited,1999
2. MechanicsofmaterialsbyJames M.Gere.
3. IntroductiontoengineeringmaterialsbyB.K. Agarwal.
4. Physicalmetallurgyandadvanced materials byR.E. Small man.
5. EngineeringmechanicsofcompositematerialsbyIsaacM.Daniel.
6. U.C.Jindal,“EngineeringMaterialsandMetallurgy”,Pearson,2011.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletionofcourse,thestudentwill beableto:

CO1:Understandthevarious crystalstructureusingball andstickmodels.

CO2:Todemonstrate,analyseandpredictthemechanicalbehaviourpresentindifferentengineering materials such as CI, MS etc.

CO3:Tounderstandtheworkingofhardnesstestingmachineslike Rockwell,Brinell’shardnessm achinesand instruments likedial gauge,VarnierCallipersetc.

CO4:Understandthevariousheat-treatmentmethodsandtheireffectonmicrostructureandmechanicalproperties

CO5:Understandthepropertiesofmaterialsusingdestructivetesting.

COs	*POs/PSOs*
CO1	*PO1/PSO3*
CO2	*PO1/PSO3*
CO3	*PO1/PSO3*
CO4	*PO1/PSO3*
CO5	*PO1/PSO3*

BME C0002APPLIEDTHERMODYNAMICS

Pre-requisite:*BasicMechanicalEngineering*

Objective: Toapplybasicsofthermodynamicsandphysicsindesignofthermodynamicsystems.

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Basics of thermodynamics:** Learning Objective, Definition, First law,Secondlaw,conceptofentropy,differentialentropyrelations. **ThermodynamicsRelation:**,LearningObjective,Introduction,Helmholtz and Gibbs Function, Maxwell Relation, Chaperon Equation,Joule Thompson Coefficient and Inversion Curve, Coefficient of VolumeExpansion,AdiabaticandIsothermalCompressibility. **AvailabilityandIrreversibility:**LearningObjective,Introduction,AvailableandUnavailableEnergy,AvailabilityandIrreversibility,SecondLawEfficiency.**SteamGenerator:**LearningObjective,Introduction,Steamproperties,FunctionofBoilers,ClassificationofBoilers, Modern Boilers, Working of Fire Tube and Water Tube Boiler,Mountings and Accessories, Draughtand ItsCalculation, PerformanceofBoilers.Heatbalancesheetofboiler. **Condensers and Cooling Towers:**Learning Objective, Introduction,FunctionofCondenser,CondensingSystem,SurfaceandJet Condensers,MassofCirculatingWater,CondenserandVacuumEfficiency,Cooling Tower:Construction Details andAnalysis.	22
II	**VapourPowerCycle:**LearningObjective,Introduction,ReviewofCarnot and Rankine Cycle, Effect of Operating Conditions on ThermalEfficiency of Rankine Cycle, Principle Methods of Increasing ThermalEfficiency,DeviationofActualCycleFromTheoreticalCycle,RegenerativeFeedHeatingCycles,ReheatingandRegenerativeCycles ,Binary Vapour Cycle. Case study of design and installation of thermalpower plant of 500 MW to fulfill requirement of small medium city .**FlowThroughNozzlesandDiffusers:**LearningObjective,Introduction,ClassificationofNozzlesandDiffusers.SteadyFlowEnergy Equation Through Nozzles, Momentum Equation. Nozzle andDiffuser Efficiencies, Mass Flow Rate Through Nozzle Under IsentropicFlowCondition,GeneralRelationship,BetweenArea,VelocityandPressureinNozzlesandDiffuser,SupersaturatedFlowThroughNozzles,EffectofVariationofBackPressureinNozzle. **SteamTurbines:**LearningObjective,Introduction,PrinciplesofWorkingofSteamTurbines,Classification&Comparison,VelocityDiagramFor ImpulseandReactionTurbines.Staging,StageandOverall Efficiency,Reheat Factor,Bleeding.	23
	Totalcontacthours(lectures)	45

Text Books:

- Domkundawar S, Kothandaraman C.P, Domkundawar A.V “Thermal Engineering” Dhanpat Rai &Sons.
- Yadav R., “*Steam & Gas turbines and Power Plant Engineering*”, VII ed., 2004, Central Publishing HouseAllahabadRajputR.K.,“*ThermalEngg*.”DhanpatRai&Sons.
- NagP.K.,“*BasicandAppliedThermodynamics*”,TMHPublicationNewDelhi.
- KeartonW.J.,“*TheoryofSteamTurbine*”, DhanpatRaiandSons

Reference Books:

- YunusA.Cengel. AndMichaelA.Boles., “Thermodynamics:AnEngineering Approach”, McgrawHillEducation
- Ennis W.D.,“AppliedThermodynamicsForEngineers”,D.VanNostrandCompany.
- Davies D.,Jeremy.,“ConciseThermodynamics:PrinciplesandApplications”,HorwoodPublishing
- McConkeyA.andEastopT.,“AppliedThermodynamicsforEngineeringTechnologists”PearsonIndia

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletingthissubjectstudentswillbeableto:

CO1.Determinetheavailabilityandirreversibilityofopenandclosedsystemthermodynamiccycles.(Understand)
CO2. Understand Maxwell’s and thermodynamic relations of gas mixtures.(Understand)CO3.Understandtheworkingofboilersandevaluate theboilerperformance.(Understand)
CO4.EvaluatethethermalefficiencyofRankine cycle,regenerativecycleandreheatcycle.(Understand)
CO5.UnderstandtheworkingofcondensersandcoolingtowersandevaluatetheCondenserseffic iencyandvacuum efficiency.(Understand)
CO6.Understandbasicconcepts,energyequationsandworkingofnozzleanddiffuser.(Understand)
CO7.Understandtherelationshipbetweenarea,pressureandvelocityofsteamnozzlesanddif fusersandevaluatetheefficiencyofnozzlesanddiffusers.(Understand)
CO8.Analyzeimpulseandreactionsteamturbomachinesforenergytransfer.(Apply)

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**PSO/PO**
CO1	PSO1/PO1/PO2/PO5/PO6
CO2	PSO1/PO1/PO2
CO3	PSO1/PO1/PO2/PO6
CO4	PSO1/PO1/PO5/PO6
CO5	PSO1/PO1/PO5/PO6
CO6	PSO1/PO1/PO5/PO6/PO7
CO7	PSO1/PO1/PO3/PO5/PO6/PO7
CO8	PSO1/PO1/PO3/PO5/PO6/PO7

BMEC0003MEASUREMENTANDMETROLOGY

Objective:

To develop in students the knowledge of basics of Measurements, Metrology and Measuring devices.

Credits:02 **Semester IV** **L–T–P:2–0–0**

ModuleNo.	Content	Teaching Hours
I	**Introduction to measurement:** Generalized measuring system and itsfunctionalelement,unitsofmeasurement,staticcharacteristicsofmeasuringinstruments,SystematicandRandomerrors,Statisticalanalysis of errors,Calibration. **Measurementofgeometricforms:**Measurementofroundness,flatness andstraightness. **SensorsandTransducers:**Introductiontosensorsandtransducers.**Limits, fits and Tolerances:** Interchangeability, selective assembly,limits,fit andtolerances,limitgauging,design oflimitgauges.	15
II	**StrainMeasurement:**TypesofStrainGaugesandTheirWorking,StrainGaugeCircuits,TemperatureCompensation. **MeasurementsofForceandTorque:** IntroductiontoDevicesused forMeasuring ForceandTorque. **LinearMeaurementandAngularMeasurement:** Steelrule, verniercaliper,vernierheightgauge,verniermicrometers,Anglegauges,sinebar,slipgauges,vernierbevelprotractor. **SurfaceTexture:**SurfaceRoughness,QuantitativeEvaluationofSurfaceRoughness andItsMeasurement. **Comparators:**Sigmacomparator,Johansson'sMicrokrator.	17

TextBooks:

- KumarD.S.,"*MechanicalMeasurementsandControl*",Metropolitan,N.Delhi.
- TayalA.K.,"*InstrumentationandMechanicalMeasurement*",GalgotiaPublishers.
- JainR.K.,"*Measurement&Metrology*",KhannaPublications.

ReferenceBooks:

- DobilinErnest,"*MeasurementSystemsApplicationandDesign*",TMH.
- Bewoor.,"Metrology&Measurement",TMHpublicationnewDelhi.
- KennethJohnHume.,"Engineeringmetrology",Macdonald.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

At the end of this course students will be able to

*CO1.Understandthemeasurementsystems,unitsanddimensionsandcharacteristicsofmeasuringinstruments.**(Understand)***
*CO2.Explainthevariousformmeasurementslikestraightness,flatness, roundness.**(Understand)***
*CO3. Understand working of suitable instruments for typical measurements like strain, force andtorque.**(Understand)***
*CO4. Identifymethodsanddevicesformeasurementoflengthand angle. **(Understand)***
*CO5.Understand concepts of limits, fits and tolerances in industrial application. **(Apply)***
*CO6.Designoflimitgauges.**(Apply)***
*CO7.Determineandmeasureofsurfaceroughness.**(Understand)***

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	PSO/PO
CO1	PSO1/PSO2/PSO3/PO1/PO6
CO2	PSO2/PSO3/PO1/PO2/PO6
CO3	PSO2/PSO3/PO1/PO2/PO6
CO4	PSO2/PSO3/PO1/PO2/PO3/PO6
CO5	PSO2/PSO3/PO1/PO5
CO6	PSO3/PO1/PO3/PO5
CO7	PSO2/PSO3/PO1/PO3/PO5

BME C0801MEASUREMENTANDMETROLOGYLAB

Objective: Toeducatestudentsondifferentmeasurementinstrumentsandoncommontypesof errors.

Credits: 01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**ListofExperiments:** • ToFind OuttheErrorinthemeasurement ofthegivenspecimenUsingVernierCaliper. • ToAnalyzedtheDeviationinDiameterofAGivenSpecimenUsin g Micrometer. • ToMeasuretheAngleofAGivenSpecimen(WoodenBlock)Usin g SineBarandSlipGauges. • To Study the Limit Gauge For Better Understanding of Limits,Fits andTolerances. • ToObservetheAngularMeasurementsofAGivenSpecimenUsi ng VernierBevelProtector. • ToPerformStrainMeasurementinCantileverBeamUsingStrainGa ugeByApplyingtheDifferentLoads. • ToFind OuttheCircularityofACylindricalRodUsingDialGaugeIndic atorandV-Block. • ToFindOuttheSpeed ofAnyRotatingPart(I.E.,CeilingFan)Using Stroboscope(Non-ContactDevice). • ToMeasuretheHeightofAGivenSpecimenUsingHeightGauge. • ToDeterminetheTemperatureofAHeat BathUsingResistanceTypeDetector(RTD) andThermocouple. • ToMeasuretheLinearDisplacementUsingLinearVariableDif ferentialTransformer(LVDT). • ToMeasurethePressureUsingBourdonGaugeandStrainGauge. • To Determine the Torque of A Rotating Shaft Using Strain GaugeCoupledWithTorqueSensor. • ToFindOuttheFlatnessofASurfacePlateUsingSpiritLevel. • To determine the various elements of a threaded specimen withthehelpof profileprojector.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *At the end of this course students will be able to*

CO1.UnderstandanddetermineerrorinthemeasurementusingVerniercalliperandMicrometer. ***(Understand)***
*CO2.DetermineangleusingsinebarandVernierbevelprotractor.****(Understand)***
*CO3. Understand limits,fitsandtolerancesusing limit gauges.****(Apply)***

CO4. Understand theconcept ofcircularityusingcircularitytesteon Vblockand dialgauge. ***(Understand)***
CO5.Determinetheelementsofathreadedspecimenwiththehelpofprofileprojector. ***(Apply)***
*CO6. Determinespeedofrotatingpartusing noncontactabledevice.****(Understand)***
CO7.UnderstandworkingofLVDT,RDT,Thermocouples,straingaugeandbourdongauge. ***(Understand)***
*CO8. DetermineheightusingVernierheightgauge.****(Understand)***

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**PSO/PO**
CO1	PSO2/PSO3/PO1/PO3/PO5/PO6
CO2	PSO2/PO1/PO3/PO6/PO5
CO3	PSO2/PSO3/PO1/PO5
CO4	PSO2/PSO3/PO1/PO3/PO5/PO6
CO5	PSO2/PSO3/PO1/PO3/PO5
CO6	PSO1/PSO2/PSO3/PO1/PO5
CO7	PSO1/PSO2/PSO3/PO1/PO3/PO5/PO6
CO8	PSO2/PSO3/PO1/PO5

BMEC 0004 HEAT & MASS TRANSFER

Pre-requisite: *AppliedThermodynamics*

Objective: Todeveloptheunderstandingofbasicofheattransfermechanismandtheirapplicationinindustry.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Heat Transfer:** Basic concepts of heat transfer, Effect ofTemperature on Thermal Conductivity of Materials; Introduction to CombinedHeatTransferMechanism,EngineeringApplicationsofHeatTransfer. **Conduction:** Fourier's law of heat conduction for homogeneous, isotropicmedia, One-Dimensional General Differential Heat Conduction Equation in theRectangular, Cylindrical and Spherical Coordinate Systems (Case of constantthermal conductivity); Significance of thermal diffusivity, Initial and BoundaryConditions. **SteadyStateOne-DimensionalHeatConduction:**CompositeSystemsinRectangular, Cylindrical and Spherical Coordinates With and Without EnergyGeneration;ThermalResistanceConcept;AnalogyBetweenHeatandElectricityFlow;ThermalContactResistance;CriticalThicknessofInsulation. **ExtendedSurfaces(Fins):**Introduction,types,Generalequations,Finefficiencyandeffectiveness,FinsofUniformCross-SectionalArea,Finapplications. **Transient Conduction:** Transient Heat Conduction; Lumped CapacitanceMethod; Non-dimensional numbers in conduction – Significance of Biot andFouriernumbers,TimeConstant;UnsteadyStateHeatConductioninOneDimensionOnly,HeislerCharts. **NaturalConvection:**PhysicalMechanismofNaturalConvection;Characteristic Length,Non-dimensionalnumberswiththeirsignificanceEmpirical Heat Transfer Relations for Natural Convection Over Vertical PlanesandCylinders,Horizontal PlatesandCylinders.	20
II	**ForcedConvection:**BasicConcepts;HydrodynamicBoundaryLayer;ThermalBoundaryLayer;energyequation,ConcentrationBoundaryLayerNon-dimensionalnumberswiththeirsignificanceLocalandaverageheattransfer coefficients, Flow Over a Flat Plate; Empirical Heat Transfer Relations;**Radiation:**GrayBody;ShapeFactor;Black-BodyRadiation;RadiationExchange Between Diffuse Non Black Bodies in An Enclosure; Radiation Shields;Radiation from cavities, Electrical Analogy of Radiation Heat Transfer; SolarRadiation. **Heat Exchanger:** Introduction ,Types of Heat Exchangers; Fouling Factors;OverallHeatTransferCoefficient;Analysisofheatexchangers:LogarithmicMeanTemperatureDifference(LMTD)Method;Correctionfactorcharts,Effectiveness-NTUMethod;,HeatPipes **CondensationandBoiling:**IntroductiontoCondensationPhenomena;Dropwise Condensation;BoilingModes, Pool Boiling;	20

Text Books:

- YadavR.,“*HeatTransfer*”,CentralPublishingHouse,Allahabad,2018
- Rajpoot,R.K.“HeatandMassTransfer”,S.ChandPublications,2018
- D.S.Kumar,“HeatandMass Transfer”S.KKataria&sons, 2008

ReferenceBooks:

- Bayazitouglu&Ozisik,“*ElementsofHeattransfer*”,T.M.H.,2015
- HolmanJ.P.,“*HeatTransfer*”,McGraw-HillInternationaledition.2016
- Pitts&Sisson,“*Schaum'soutlineofHeatTransfer*”,McGraw-HillInternationaledition,2018
- FrankKreith,“*PrinciplesofHeatTransfer*”,McGraw-HillBookco.,2019

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletionofcourse,thestudents will beableto:

- Determinetheoverallthermalconductivityofcompositewallofa Furnace.
- Determinethe criticalthicknessofinsulationofsteampipesofthermalpowerplant.
- Evaluatetheeffectivenessandefficiencyofheattransferof Finsofmotorbikeengine.
- Determinetheheattransfereffectivenessofshellandtubeheatexchangers.
- Understandmassdiffusion rateincaseofevaporativecooling incoolingtowers.
- Understandthe effectsoffoulinginboilertubesofthermalpowerplant.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO1,PO2/PSO1,PSO2
CO6	PO1,PO2/PSO1,PSO2

BME C0802HEATANDMASSTRANSFERLAB

Objective: Heat Transfer is one of the important subjects which is commonly applied in renewable energy,industrial, commercial and domestic systems. The experiments are designed to provide exposure of practicalaspects of the various theoretical concepts developed under the course, Heat and Mass Transfer. The laboratoryconsistsofexperimentsonvariousconductive,convective,radiative,boilingmechanismsofheattransfer.

Credits:01 **SemesterV** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments • ToDeterminetheOverallHeatTransferCoefficientForaCompositeWall • TodeterminethethermalConductivityofaMetallicRod andDraw a Graph Between Variation in Conductivity andTemperature. • To Determine the Heat Transfer Rate Through the CompositeCylinder and the Overall Heat Transfer Coefficient of CompositeSystem • ToDeterminethethermalConductivityofLiquid • ToDeterminethethermalContactResistanceofaCompositeWall • ToDeterminetheCriticalThicknessof insulationofaLaggedPipe. • To Determine the Heat Transfer Through a Heat Pipe & Draw aTemperatureDistributionProfileUnderSteadyStateCondition • To Determine the Heat Transfer & Temperature DistributionAlong a Uniform Cross- Section Fin Under Steady State in FreeConvection. • To Determine the Heat Transfer & Temperature DistributionAlongaUniformCross-SectionFinUnderSteadyStateinForcedConvection. • ToDeterminetheSpecificHeat ofAirunderSpecifiedatmosphericConditions. • ToDeterminetheCriticalHeatFlux Through aGivenWire(NichromeWire)in aPoolBoilingProcess. • To Determine the Heat Transfer & Overall Heat TransferCoefficientinaCounterFlow&ParallelFlowHeatExchanger. • ToDeterminetheStefanBoltzmannConstantUnderGivenCondition. • ToDeterminetheEmissivityofATestPlate. • ToDeterminetheViewFactor/ShapeFactorofAGivenArrangement.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes: Aftercompletionofcourse,thestudentswillbeableto:

- *CO1*Determine theoverallthermalconductivityofcomposite wallofaFurnace.
- *CO 2*Determinethe criticalthickness ofinsulationofsteampipes ofthermalpowerplant.
- *CO3*Evaluatetheeffectivenessandefficiencyofheattransfer ofFinsofmotorbikeengine.
- *CO4*Determinetheheattransfereffectivenessofshellandtubeheatexchangers.
- *CO5*Understandmassdiffusionrateincaseofevaporativecoolingincoolingtowers.
- *CO6* Understandtheeffectsoffoulingin boiler tubesofthermalpowerplant.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO1,PO2/PSO1,PSO2
CO6	PO1,PO2/PSO1,PSO2

BMEC0005FLUIDMECHANICS

Objective: It is major branch of mechanics. It introduces students about fluid and its difference with solids.Geometry of fluid flow can be visualized. Its importance lies in its wide ranging applications in fluid power engineering and mechanics of fluid flow. It also discusses various empirical relations which are helpful in boundary layer applications.Itprovidesbasisforcomputationalfluiddynamics.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Fluid and Continuum, Physical Properties of Fluids,Rheologyof Fluids. **Dimensional Analysis and Hydraulic Similitude:** DimensionalAnalysis,Buckingham'sPiTheorem,ImportantDimensionless Numbersand Their Significance, Geometric, Kinematic and Dynamic Similarity,Model Studies. **Fluid Statics:** Pressure-Density-Height Relationship,Manometers, Pressure Transducers, Pressure on Plane and CurvedSurfaces, Centre of Pressure, Buoyancy, Stability of Immersed andFloating Bodies. **KinematicsofFluidFlow:**TypesofFluidFlows:Continuum&FreeMolecular Flows.SteadyandUnsteady,UniformandNon-Uniform,LaminarandTurbulentFlows,RotationalandIrrotationalFlows,Compressible and Incompressible Flows, Subsonic, Sonic and SupersonicFlows, Sub-Critical, Critical and Supercritical Flows, One, Two and ThreeDimensionalFlows, Streamlines,ContinuityEquationFor3Dand1DFlows,Circulation,StreamFunctionandVelocityPotential.	20
II	**Dynamics of Fluid Flow:** Euler's Equation of Motion Along A Streamlineand Its Integration, Bernoulli's Equation and Its Applications-Pitot Tube,OrificeMeter,VenturiMeterandBendMeter,NotchesandWeirs,MomentumEquationandItsApplication toPipeBends. **Laminar and Turbulent Flow:** Equation of Motion For Laminar FlowThrough Pipes, Stoke's Law, Transition From Laminar to Turbulent Flow,TypesofTurbulentFlow,MixingLengthConceptandVelocityDistributioninTurbulentFlowOverSmoothandRoughSurfaces,ResistancetoFlow,MinorLosses,PipeinSeriesandParallel,PowerTransmission ThroughAPipe,Siphon,WaterHammer. **Boundary Layer Analysis:** Boundary Layer Thickness, Boundary LayerOver A Flat Plate, Laminar Boundary Layer, Application of MomentumEquation, Turbulent Boundary Layer, Laminar Sublayer, Separation andIts Control,Drag and Lift, Drag on A Sphere, A Two Dimensional Cylinder, and An Aerofoil,Magnus Effect,Kutta-Jonkowski Theorem.	20

Text Books:

- BansalR.K.,“*FluidMechanics*”,LaxmiPublications.2016.
- Modi,P.N.,andSeth,S.H.,“*HydrualicsandFluidMachines*”,StandardBookHouse,2010.
- AgarwalS.K.“*FluidMechanics&Machinery*”,TMH,2010.
- GuptaVijayandGuptaS.K.,“*Fluid Mechanicsand itsApplications*”,WileyEasternLtd,1984.

Reference Books:

- NarasimhanS., “*FirstCourseinFluid Mechanics*”, UniversityPress,2012.
- Som,S.K.& BiswasG.,“*Introductionoffluid mechanics&Fluid Machines*”, TMH,2000.
- DasM.M.,“*FluidMechanics&Turbomachines*”,OxfordUniversityPress,2013.
- Garde,R.J.,“*Fluid MechanicsthroughProblems*”, NewAgeInternationalPvt. Ltd,NewDelhi,2015.
- Shames,I.H.,“*MechanicsofFluids*”,McGrawHill,Int.Student,Education,2017.

Outcome: Onlearningthissubject studentswillbeableto:

- *CO1*:Identifyandobtainthevaluesoffluidpropertiesandrelationshipbetweenthem.
- *CO2:*Understandtheprinciplesofcontinuity,momentum,andenergyasappliedtofluidmotions.
- *CO3*:Calculatehydrostaticforceonsubmerged surfaceinastaticfluid.
- *CO4*: Calculatebuoyancyforce tounderstandthestabilityconceptofthefloatingbody.
- *CO5:* Applydimensionalanalysistopredictphysicalparametersthatinfluencetheflowinfluidmechanics inengineeringapplications.
- *CO6*:Relate fundamentalsoffluidmechanicstothewidespectrumofreal lifeproblems.
- *CO7*: Tacklereal lifeproblemsrelatedtosupplyanddistributionoffluidindomesticandindustrialsector.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2,PO3/PS1
CO4	PO1,PO2,PO3/PS1
CO5	PO1,PO2,PO3/PS1
CO6	PO1,PO2,PO12/PS1
CO7	PO1,PO2,PO12/PS1

BMEC0803 FLUID MECHANICS LAB

Objective: This lab is runin conjunctionwith thetheory course.Itis an introductory course where flowbehavior, fluidforcesandanalysistoolsareintroduced.It coversmeasuringdevicesandtechniques, erroranalysis in experimental works and analysis of assumptions in the theory of fluid mechanics. The laboratoryprovidestrainingtoundergraduateandgraduatestudentsinflowmeasurements.

Credits:01 **L–T–P:0–0–2**

Modul eNo.	Conten t	Teachin gHour s
I	**ListofExperiments:** • ToDetermineCoefficientofDischargeofGivenShapeofOrifice. • To Determine Coefficient of Discharge of Given Shape ofVenturimeter. • ToDemonstratetheTransitionFromLaminartoTurbulentFlo wand toDetermineLowerCriticalReynoldsNumber. • ToDeterminetheLossofHeadsforPipeFittings. • ToDetermineCoefficientofDischargeofGivenShapeofMo uthPiece. • ToDeterminetheMetaCentricHeight oftheGiven ShipModelExperimentally. • ToDetermineCoefficient ofDischargeofAGivenShapeofV-Notch. • ToVerifyBernoulli'sTheoremExperimentally. • ToStudytheBoundaryLayerVelocityProfileOverAFlat PlateandtoDeterminetheBoundaryLayerThickness. • ToVerifyMomentumTheoremUsing MomentumTheoremApparatus. • ToDetermineCoefficientofDischargeforFlowOverARec tangularWeir. • ToDeterminetheFrictionFactorforFlowThroughPipes • VirtualDemonstrationofVelocity,ViscosityandPressureMe asuring Devices.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Onsuccessfulcompletionofthecourse,thestudentwillbeableto,

- *CO1:Enhancetheirknowledgeofbasicprinciplesoffluidmechanics.*
- *CO2:Analyzefluidflowproblems withtheapplicationofthemomentumand energyequations.*
- *CO3:Understandbasicworkingprinciplesofvariousflowsandpressuremeasuringequipmentslikemout hpiece,orificenotchesandweirs.*

- *CO4:usethetechniques,skillsandmodernengineeringtoolsnecessaryforfluidengineeringpractice.*
- *CO5:EvaluatetheMetacentricheightofsubmergedbodiestounderstandthestabilityconcept.*
- *CO6:Estimatetheminorandmajorfrictional lossesinpipeflow.*
- *CO7:VerifytheconceptofBernoulli'sequationinpipeflowexperimentally.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2,PO3/PS1
CO4	PO1,PO2,PO5/PS1
CO5	PO1,PO2,PO3/PS1
CO6	PO1,PO2/PS1
CO7	PO1,PO2/PS1

BMEC0006MANUFACTURINGSCIENCE–I

Pre-requisite:*Material Science*

Objective: *Toimpart thecomprehensiveinsight intovariousmanufacturingprocessessuchasmetalcasting,sheetmetal,weldingandadvancedweldingprocesses.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching hours
I	**Introduction:**ImportanceofManufacturing,ClassificationofManufacturing ProcessesandItsApplications. **Casting:**PatternDesign&Allowances.Gating,Riser,Runners,MoldingParametersandDesign,SolidificationofCasting,GatingSystemDesign,SandTestingMethods,CastingDefectsandRemedies.DieCasting,CentrifugalCasting,InvestmentCasting,Carbon Di-OxideCasting, **SheetmetalProcessing:**TypesofPressDie,Simple,Progressive,Compound and Combination. Punch & Die Clearance. Blanking & Piercing,CuttingandPunchingMechanism.MethodofReducingCuttingForces. Bending of Strip&SpringBack. **Welding:** Introduction and Concept of various Welding Processes, ElectricArcWeldingResistanceWelding,AtomicHydrogenWelding,GasWelding.	21
II	**Advanced Welding Processes:**Electron Beam Welding and Plasma arcWelding Process. Laser beam welding and diffusion Welding, Heat AffectedZone(HAZ)MetallurgicalAspectsofWeldJoint,WeldingDefectsandRemedies,SolidStateWeldingProcesses,FrictionWeldingProcess,ExplosiveWelding. **Metal Forming:** Metal Deformation, Yield Criteria. Concept of Inter-FacialFriction and Lubrication Mechanism in Manufacturing. Determination andCalculation of Pressure Distribution With Sliding Friction for Drawing andExtrusion of Wire/Strip, Conditions for Rolling, Force and Power in Rolling,Limiting ThicknessandReduction. **AdvancedMetalFormingProcesses:**UnconventionalMetalFormingProcesses- Explosive Forming, Electromagnetic Forming, Electro-HydraulicForming,Hydro-StaticExtrusion,Hydro-DynamicWire Drawing,ConceptandApplicationsofPowderMetallurgy.	21

RecommendedBooks:

- Sharma P.C.,“*ManfacturingEngineering*”,S.ChandNewDelhi
- GrooverM.P., “*ManufacturingProcess:MaterialsofSystems*”,John Wiley&Sons,Inc.
- Serope**Kalpakjian,**“*ManufacturingProcess*”,AddisonWesleyPublishingCo.

- GhoshandMalik,"*Manufacturingscience*",EastWestPvt.Ltd.
- Boothroyd, "*FundamentalofMetalCutting and MachineTools*", John Wiley& Sons,Inc.
- OstwaldPhillipF.,"*ManufacturingProcess*",JohnWiley&Sons,Inc.
- DeGarmo,"*Materials&Manufacturing*",WileyPublications.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:Students areexpectedtolearn:

Oncompletionofthiscourse,thestudents wouldbeableto:

CO1.Thestudentwillbehavingthecapability ofselectingsuitablemanufacturingprocessestomanufacturetheproductsoptimally.

CO2.Thestudent willabletounderstandthevariousmetalcasting methods,designingofriserandgatingsystemalongwithcastingdefectsandtheiranalysis.

CO3.Thestudentwillbeabletorecommendtheappropriatedesignofgatingsystems,formingprocesses,Sheet metaloperations.

CO4.Thestudentwillabletounderstandthetypesofweldingaccordingto materialsapplicationandvariousadvancedweldingmethodandthererequirementsandNDTtechniques.

CO5.Thestudentwillabletounderstandtheprocessingof variousconventionalandadvancedmetalformingprocessesandparameters.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos) andProgramOutcomes(PSOs):

CO	**POs/PSOs**
CO1	PO1,PSO2
CO2	PO3,PSO2
CO3	PO3,PSO2
CO4	PO1,PSO2
CO5	PO1,PSO2,PSO3

BMEC0804:MANUFACTURINGSCIENCE-ILAB

Objective: The purpose of this lab is to enable the students to have the practical skills for basic manufacturingoperations e.g. Preparation of Sand, Making Pattern with allowances, Preparation of different types of mouldswith cores for various castings. The student will also have practical exposure to Press work and die assembly andmachining processes on various machine tools such as Spur gear on milling machine, knurling Bush on CapstanLatheandpreparationofSinglepointcuttingtoolonToolGrindingmachine.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**ListofExperiments-** • ToStudyand AnalyzeDifferent TypesofPatternsConsidering: (A) Shape(B) Size(C) PartingLine • ToDesignandFabricatethePatternforAGivenComponentConsideri ng Different Allowances and Surfaces Which RequireMachining. • To Make A Casting for Half Bush Gland By SelfHanging CoreMouldasPerGivenDimensions. • To Make A Casting for Hollow Step Pulley With the Help of GreenSandMould. • ToPreparetheBushGlandFromMetalByUseofDiesCastingMethod. • ToPrepareABarofCircularCrossSectionFromSquareBarKeep ing LengthConstant. • ToPreparetheRing ByUsing theBending andForgeWeldingOperation. • ToMakeaWasherbyUsing Combination DieandtoStudyHowProgressiveDieisDifferentfromCombination Die. • ToAnalyzetheFlowPatternDuringTubeBendingProcess. • To Analyze the Flow Pattern and Die Load During DirectExtension Process By Using Dies of Different Shapes and CrossSectionDuring: (A) DifferentReductionRatio(B)DifferentShapes • ToMakeA 10T.P.I.(R.H.) Thread on M.S.BarforHexagonalBoltWiththeHelp ofCentreLatheMachineas PerGivenFigure. • To Make A Cast Iron Block and Make A Key Way on Its SurfaceWiththeHelp ofShaperMachineas PerGivenFigure. • ToMakeAPlain(Spur)Gearof10TeethonMillingMachineasPerGi venFigure. • ToMakeAKnurling Bushon CapstanLatheasPerGivenDimensions andSketch. • ToMakeASinglePoint CuttingToolAnglesWiththeHelpofToolGrindingMachineA PerGivenDimensions and Sketch.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: On successful completion of this lab, the students will be able to:CO1:DemonstrateanunderstandingofandcomplywithFoundryShop;

CO2:Abletousetoolsformouldpreparation,coresformanufacturingthecastingobjects;CO3:Identifythedefectsproducedincastings;

CO4:AbletogaintheknowledgeofbasicoperationofHandForging;CO5: Able to perform the basic operations of Hand press machine;CO5:Abletoperform theoperationson LatheMachineTool;

CO6:AbletogaintheoperationalknowledgeofShaperandMillingMachineTool.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PSO3
CO2	PO1
CO3	PO1
CO4	PO1,PO3
CO5	PO1
CO6	PO1,PO3,PSO3

BMEC0007STRENGTHOF MATERIALS

Pre-requisite:*AppliedMechanics*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Stress and Strain:** Simplestress, typesof stressesand strains, hook'slaw,principle of superposition, Elastic constants, bars of varying section, uniformlytaperedbars,elongationofbarduetoself-weight,compoundbars,Indeterminatestructures,Thermalstressesinuniformbars .Strainenergy,impactloading. **Simple Bending of Beams:** Theory and assumptions of Pure Bending, Stressesin Beams Under Different Types of Loads, Beam of uniform strength, Directshearstressesin beams. **Torsion:** Torsion of Circular shafts, design of shaft, stress and strain in pureshear,Staticallyindeterminatetorsionalmember,strainenergyintorsion. **Slope and Deflection of Beams:** Slope and Deflection of Statically DeterminateBeamsUsingMacaulay'sMethod,Area-Moment andCastigliano'sTheorem.	22
II	**Compoundstressandstrain:**Introduction,planestress,principleplanes,principle stresses and maximum shear stresses, Mohr's circle for plane stress,hook's law for plane stress, tri-axial stress, transformation equations for planestress, plane strain. **Theories of Elastic failures:** Rankine's theory, St. Venenttheory,Guest'stheory,Haigh'stheory,Maximumdistortionenergytheory,graphicalrepresentationandtheircomparison. **Columns:** Euler's Theory of Buckling of A Column, Middle-Third and Middle-Quarter Rules, End Conditions For Columns, Different Empirical Formulae ForColumns. **PressureVessels:**StressesandStrainsinThinandThickCylindersandSpheresSubjected toInternalandExternalPressures. **Springs:**DeflectionofHelicalSprings(opencoilandclosedcoil)UnderDifferentTypesofLoads,Springs inSeriesand Parallel,LeafSprings.	24

TextBook

- L.S.Shrinath, "MechanicsofSolids":TataMcGraw-HillPublication,2009.
- B.J.Goodno andJ.M. Gere,"Mechanicsof materials, 9e":CenageLearning,2018.
- B.C.Punamia, A.K.JainandA.K.Jain, "Mechanicsofmaterials": LaxmiPublication,2017.
- R.K.Rajput,"ATextbookof StrengthofMaterials(MechanicsofSolids)inSIUnits7e":SChand,2018.

ReferenceBooks:

- G.H.Ryder,"StrengthofMaterials":MacmillanPublishersIndiaLimited,2002.
- S. P. Timoshenko and D. H. Young, "Elements of Strength of Materials": Affiliated East-West Press,2003.

- F.P.Beer and E.R.Johnston, "MechanicsofMaterials(SIE)7e":McGrawHillEducationIndiaPrivate Limited,2017.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:Understand**theconceptsofstressandstrainatapointaswellasthestress-strainrelationshipsforhomogenous,isotropicmaterialsand**classify**thetheoriesof failureforstatic loading.
- **CO2:Calculate**thestressesandstrainsinaxialloading,bendingofbars,circulartorsionmembers,andmemberssubjecttoflexuralloadingsandmemberssubjected tocombined loading.
- **CO3:Draw**ShearForceandBendingMomentdiagramsofvarioustypesofbeamssubjectedtodifferentloads.
- **CO4:Determine**theslopeanddeflectionsproducedbythethreefundamentaltypesofloads:axial,torsional,andflexural.
- **CO5:Compute**and**illustrate**theprincipalstresses,maximumshearingstress,andthestressesactingonastructuralmember.
- **CO6:Calculate**thestressesandstrainsassociatedwiththin-wallsphericalandcylindricalpressurevessels.
- **CO7:Understand**thephenomenonofbucklingofcolumnsand**calculate**thecriticalloadforslender,longcolumnssubjectedtoaxial loads.

MappingofCourseOutcomes(COs)withProgram outcomes(POs)andProgram SpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO3,PO4/PSO3
CO5	PO2,PO3/PSO3
CO6	PO2,PO3,PO4/PSO3
CO7	PO2,PO3/PSO3

BMEC0008KINEMATICSOFMACHINES

Pre-requisite:*AppliedMechanics*

Objective: Toexplainvariousgoverninglawstounderstandmechanism,todevelopmachinesbasedon simplemechanismandunderstandforcesinvolved.Tounderstanddifferenttypesofgearsbasedonlink mechanisms

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:**Definitions:Link,kinematicpairs,kinematicchain,mechanism,structure,degrees of freedom, Classification links, Classifiction of pairs based on type ofrelativemotion,Grubler\'scriterion,mobilityofmechanism,Groshoff'scriteria,inversionsofFourBar ,SingleSliderandDouble SliderCrank. **SPECIAL MECHANISMS:** Exact Straight Line Motion Mechanisms - Peaucellier's, Hart andScottRussellMechanisms,ApproximateStraightLineMotionMechanisms–Grass-Hopper, Watt and Tchebicheff Mechanisms, Pantograph, Condition for correct steering,DavisandAckermansteeringgearmechanism. **Velocity and Acceleration Analysis of Mechanisms:** Velocity and acceleration analysisofFourBarmechanism,slidercrankmechanismandSimpleMechanismsbyvectorpolygons:Relativevelocityandaccelerationofparticles.inacommonlink,relativevelocity and accelerations on separate links- Coriolis component of acceleration. Angularvelocityandangularaccelerationoflinks,velocityofrubbing.	22
II	**Velocity Analysis by Instantaneous Center Method Klein's Construction:**VelocityAnalysisbyInstantaneousCenterMethod:Definition,Kennedy'sTheorem,Determination of linear and angular velocity using instantaneous center method Klein'sConstruction:Analysisofvelocityandaccelerationofsingleslidercrankmechanism. **SpurGears**:Gearterminology,lawofgearing,pathofcontact,arcofcontact,contactratio of spur gear. Interference in involute gears, methods of avoiding interference, forminimum number of teeth to avoid interference, Simple gear trains, compoundgeartrains. Epicyclic gear trains: Algebraic and tabular methods of finding velocity ratio ofepicyclic gear trains, torque calculation in epicyclic gear trains.**Cams:** Types of cams, types of followers. displacement, velocity and acceleration curvesvelocity, Simple Harmonic Motion, Uniform Acceleration Retardation, Cycloidalmotion.Camprofiles:disccamwithreciprocating/oscillatingfollowerhaving,roller andflat-facefollowerinline.	18

TextBooks:

- S.S.Ratan,"TheoryofMachines5e":TataMcGraw-HillPublication,2019.
- J.K. GuptaandR.S. Khurmi, "TheoryofMachines14e":SChand& CoLtd,2005.

- R.K. Bansal and J. S.Brar,“ATextbookofTheoryofMachines5e”:LaxmiPublishers, 2016.

ReferenceBooks:

- J. J. Uicker, G. R. Pennock and J. E. Shigley, “Theory of Machines and Mechanisms”: Oxford UniversityPress,2014.
- A.GhoshandA.K. Mallik,“TheoryofMachinesandMechanisms”:Eastwestpress,2008.
- P.L.Ballaney,“Theoryofmachines &Mechanism”: JohnWileyPublishers,2005.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:*Afterstudyingthissubjectstudentswillbeableto:*

- **CO1:**Computetheforcesandtorquesinvolvedinfrictiondriveslikescrewthreads,clutches,belts,ropesand bandandblockbrakes.
- **CO2:**Designapossiblegeartrainanddeterminethespeeds ofsimple,compoundandepicyclicgeartrains.
- **CO3:**Sketchslowspeedandhighspeedcamprofilefortherequiredpredefinedmotionoffollower.
- **CO4:**Analyzevelocityandaccelerationofmechanisms.
- **CO5:**Calculatekinematicpropertiesofsimpleplanarmechanismsusinggraphicalapproach,instantaneous centermethodandsynthesisthemat elementarylevel.
- **CO6:**Modelplanarmechanismswhichwillhavedefinedrequired motion.

MappingofCourseOutcomes(COs)withProgram outcomes(POs)andProgram SpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO3/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO2/PSO3
CO5	PO2,PO3/PSO3
CO6	PO2,PO3/PSO3

BMEC0009:DYNAMICSOFMACHINES

Pre-requisite:*KinematicsofMachine*

Objective: The objective of this course is to provide the details of the concepts of generalized forces and Staticand dynamic force analysis, concepts of static and dynamic mass balancing. To introduce the approaches andmathematical models used dynamical analysis of machinery. To teach students concepts of free Vibration ofSingle Degree ofFreedomSystems,VibrationMeasurementandApplications, Modal Analysis.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Static and Dynamic Force Analysis:** Static equilibrium. Equilibrium of twoand three force members. Members with two forces and torque. Free bodydiagrams. Static force analysis of four bar mechanism. Dynamic force analysisofSlider Crankmechanism. **TurningMoment&Flywheel:**TurningMomentonCrankshaft,TurningMoment Diagrams- Four Stroke IC Engine and Multi-Cylinder Steam Engine,FluctuationofEnergy,Flywheel. **BalancingofRotatingandReciprocatingMasses:**StaticandDynamicBalancing, Balancing of Several Masses in the Same Plane and Different Planes,BalancingofReciprocatingMasses,BalancingofPrimaryForceinReciprocatingEngine,PartialBalancingofTwoCylinderLocomotives,Variationof TractiveForce,SwayingCouple,HammerBlow. **Governors:** Terminology, Centrifugal Governors-Watt Governor, Dead WeightGovernors-Porter&ProellGovernor,SpringControlledGovernor-HartnellGovernor,Sensitivity,Stability,Hunting,Isochronism,EffortandPowerof Governor,ControllingForceDiagramsforPorterGovernorandSpringControlledGovernors.	20
II	**Friction:**PivotsandCollarFriction-UniformPressureandUniformWear,Frictional, Centrifugal Clutches,Belt and Pulley Drive, Length of Open andCrossBeltDrive,Ratio ofDrivingTensionsfor FlatBeltDrive,CentrifugalTension, ConditionforMaximumPowerTransmission,V BeltDrive. **Gyroscopic Motion:** Gyroscopic Torque, Effect of Gyroscopic Couple on theStabilityofTwo WheelerandFourWheeler, Ships andAero-Planes. **MechanicalVibrations:**TypesofVibrations,DegreesofFreedom,Single Degree Free & Damped Vibrations, Forced Vibration of Single Degree SystemUnderHarmonicExcitation, Critical SpeedsofShaft.	20

TextBooks:

- RattanS.S.,“TheoryofMachines”,TMH.
- BallaneyP.L.,“TheoryofMachines”,KhannaPublication.
- Khurmi&Gupta,“TheoryofMachines”, S.ChandandCompanyLtd.,.NewDelhi.
- BansalR.K.,“TheoryofMachines”,LaxmiPublishers.
- SinghV.P.&ChandS.,“TheoryofMachines”,DhanpatRai&Sons.

ReferenceBooks:

- BevanThomas,“TheoryofMachines”,CBSPublishersandDistributors.
- Shingle,“TheoryofMachinesandMechanisms”,McGraw–HillInternationalEditions.
- Ghosh&Mallik,“TheoryofMachinesandMechanisms”,Eastwestpress.
- Rao&Dukkipati,“TheoryofMachinesandMechanisms”,Eastwestpress.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletingthis coursethestudentwillbeableto:

- **CO 1:** Take notice of importance of the balancing and learn procedures of the static anddynamicbalancing.
- **CO2:**Understandtheimplicationsofcomputedresultsindynamicstoimprovethedesignofa mechanism.
- **CO3:**Understandtheconceptofwhirlingofshaft,effectofgyroscopiccoupleonaeroplane.
- **CO4:**Practicallyknowhowthegovernorapparatusworks.
- **CO 5:** Determine the natural frequencies of continuous systems starting from the generalEquationof displacement.
- **CO6:**Understandthevarioustypesofvibratorymotions.

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)andProgrammeSpecific Outcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4,PO12/PSO1
CO2	PO1,PO2,PO3,PO4/PSO1,PSO3
CO3	PO1,PO2,PO4/PSO3
CO4	PO1,PO6,PO8/PSO3
CO5	PO1,PO2,Po3,PO9/PSO1
CO6	PO1,PO2,PO4,PO12/PSO1

BMEC0805:THEORYOFMACHINESLAB

Objective: ObjectivesofthisTheoryofMachineslabaretoimpartpracticalknowledgeondesignan danalysisof mechanisms for the specified type of motion in a machine. With the study of rigid bodies motions and forces forthe transmission systems, machinekinematics and dynamics canbe wellunderstood. Demonstration exercisesare provided with wide varieties of transmission element models to understand machine kinematics. Variousexperiments with governors, gyroscopes, balancing machines and universal vibration facilities are available tounderstandmachinedynamics.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments • StudyofSimpleLinkageModels/MechanismsandVerificationofGrashoff'sCriteria ofFour BarLinkages. • DeterminationofVelocityRatioandVerificationofHoldingtorqueinEpicyclicGearTrains. • DeterminationofNaturalFrequencyinLongitudinalVibratingSystem. • DeterminationofNaturalFrequencyinTransverseVibrationSystem. • ExperimentalinvestigationoftheCharacteristicsofDeadWeightMechanicalGovernor. • ExperimentalinvestigationoftheCharacteristicsofSpringControlledGovernor. • DeterminationofCriticalSpeedinWhirlingofShafts. • Study of the Principles of Gyroscope and Verification of the EquationofGyroscopicCouple. • StudyoftheConceptofStatics&DynamicBalancingofRotatingMassesinSingleandMultiPlanesandVerificationofBalancingPrinciples. • Measurement of Slip in Flat Belt under Different Belt Tensions andVaryingLoadConditions.	

TextBooks:

- S.S.Ratan,"TheoryofMachines",TMH
- Khurmi&Gupta,"TheoryofMachines",S.ChandandCompanyLtd.,.NewDelhi.
- BansalR.K.,"TheoryofMachines",LaxmiPublishers.
- SinghV.P.&ChandS.,"TheoryofMachines",DhanpatRai&Sons.

ReferenceBooks:

- Shingle,"TheoryofMachinesandMechanisms",McGraw–HillInternationalEditions.
- Ghosh&Mallik,"TheoryofMachinesandMechanisms",Eastwestpress.

- Rao&Dukkipati,“TheoryofMachinesandMechanisms”,Eastwestpress.
- Balani,“Theoryofmachines &Mechanism”,JohnWileyPublishers.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletingthis coursethestudentwillbeableto:

- **CO1:**Understandtheconceptofwhirlingofshaft,effectofgyroscopiccoupleonaeroplane.
- **CO2:**Analyzethedifferenttypesofmechanisminvolvedinthemachines.
- **CO3:**Gatherknowledgeabouttheslipandcreepphenomena occurringinbeltdrives.
- **CO4:**Practicallyknowhowthegovernorapparatusworks.
- **CO5:**knowtheconditionofStaticanddynamicbalancing.
- **CO6:**understandthevarioustypesofvibratorymotions.

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)andProgrammeSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO4/PSO3
CO2	PO1,PO2,PO9/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO6,PO8/PSO1
CO5	PO1,PO2/PSO1
CO6	PO1,PO2,PO12/PSO3

BMEC0010:MACHINEDESIGN–I

Pre-requisite:*StrengthofMaterials*

Objective: Theobjectiveofthiscourseistointroducedesignconceptsandproceduresnecessaryto designandselectamachinecomponent intermsofgeometryandmaterials,subjectedtostaticand/ordynamicload.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Mechanical Engineering Design,Design considerations, Standards inDesign,Material Selection. **Design Against Static Load:** Modes of Failure, Factor of Safety, Theories of Failure.**Design Against Fluctuating Loads:** Cyclic Stresses, Fatigue and Endurance Limit,Stress Concentration Factor, Design for Finite and Infinite Life, Soderberg, GoodmanCriteria. **Shafts:** Cause of Failure in Shafts, Materials for Shaft, Design of Shafts, Shafts SubjectedtoFatigue Loads. **Keys and Couplings:** Types of Keys, Splines, Design of Square & Flat Keys, Couplings-Designof RigidandFlexible Couplings.	20
II	**DesignofRivetedJoints:**TypesofRivetedJoints,FailureofRivetedJoint,EfficiencyofRiveted Joint,Designof BoilerJoints,EccentricLoadedRiveted Joint. **Design of Threaded Joint:** Design of Bolted Joint, Eccentrically Loaded Bolted Joint.**DesignofWeldedJoints-**StressesinButtandFilletWelds,EccentricallyLoadedJoint. **MechanicalSprings:**Materialfor HelicalSprings,Designof HelicalSpringsSubjectedtoStaticandFatigueLoading,Design ofLeafSpring. **PowerScrews:**FormsofThreads,MultipleThreads,EfficiencyofSquareThreads,TrapezoidalThreads,StressesinScrews,Designof ScrewJack. **Note:DesignDataBookIsAllowedin theExamination**	20

TextBooks:

- SharmaandAgrawal,“*MachineDesign*”,S.K.Katara&Sons.
- BhandariV.B.,“*DesignofMachineElements*”,TataMcGrawHillCo.
- ShigelyJosephE.,“*MechanicalEngineeringDesign*”,McGrawHillPublications.

ReferenceBooks:

- ValanceAlexandDoughtieVI,“*DesignofMachineMembers*”,McGrawHillCo.
- SpottM.F.,“*Machinedesign*”,PrenticeHallIndia.
- MaleevandHartman,“*MachineDesign*”,CBSPublications.
- Black&Adams,“*Machinedesign*”,McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Attheendofthecourse,astudentwillbeableto

- **CO1:**Analyzethestressesinmachineelementsandstructuralmembersundervariousloads.
- **CO2:**Applymultidimensionalfailurecriteriaintheanalysisanddesignofmachinecomponents.
- **CO3:**Understandthecausesofstructuraljointsfailures.
- **CO4:**Designandselectionofstructuralriveted,boltedandweldedjoints.
- **CO5:**Designanddeterminethefatiguelifeofcircularshaftsunderthecombinedloadings.
- **CO6:**Selectionofmechanicalkeys.
- **CO7:**Designofrigid&flexiblecouplings.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1, PO2/PSO1
CO2	PO3, PO4/PSO1
CO3	PO1,PO2,PO3/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO2,PO3/PSO1
CO6	PO1,PO2,PO3/PSO1
CO7	PO1,PO2,PO3/PSO1

BMEC0806:MACHINEDESIGN–ILAB

Objective: The primary objective of this course is to demonstrate how engineering design uses the manyprinciples learned in previous engineering science courses and to show how these principles are practicallyapplied Estimate fatigue strengths of steel parts. Applytechniques of combined stress and Mohr's circle inmachine designsituations.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments **StudentsareAdvisedtoUseDesignDataBookFortheDesign.Drawing Shall be Made Wherever Necessary (Using CAD-SoftwareSuchasAutoCAD).** • Design&DrawingofCotterJoint. • Design&DrawingofKnuckleJoint. • DesignofMachineComponentsSubjectedtoCombinedSteadyandVariableLoads. • Design&DrawingofEccentricallyLoadedRivetedJoint. • Design&DrawingofBoiler RivetedJoint. • DesignofShaftforCombinedConstantTwistingandBendingLoads. • DesignofShaftSubjectedtoFluctuatingLoads. • Design&DrawingofFlangedTypeRigidCoupling. • Design&DrawingofFlexibleCoupling. • DesignofHelicalSpring. • DesignofLeafSpring. • DesignofHelicalSpringSubjectedtoFluctuatingLoad. • DesignofScrewJack. • DesignofEccentricallyLoadedWeldedJoint. • DesignofEccentricallyLoadedThreadedJoint.	

TextBooks:

- SharmaandAgrawal,“*MachineDesign*”,S.K.Katara&Sons.
- BhandariV.B.,“*DesignofMachineElements*”,TataMcGrawHillCo.
- ShigelyJosephE.,“*MechanicalEngineeringDesign*”,McGrawHillPublications.

ReferenceBooks:

- ValanceAlexandDoughtieVI,“*DesignofMachineMembers*”,McGrawHillCo.
- SpottM.F.,“*Machinedesign*”,PrenticeHallIndia.
- MaleevandHartman,“*MachineDesign*”,CBSPublications.
- Black&Adams,“*Machinedesign*”,McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*At theend ofthecourse,a studentwill beable to*

- **CO1:**Understandtheconceptsofgeometricandsolidmodelling.
- **CO2:**DesignofMachineComponentsSubjectedtoCombinedSteadyandVariableLoads.
- **CO3:** Model and simulate the mechanical engineering parts and components which includeCotter Joint, Knuckle Joint, structural joints, shaft, spring & screw jack along with theirassemblyinaCAD package.
- **CO4:**Studentswillbeabletoidentifyandanalyzepracticalproblems.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1, PO5/PSO1
CO2	PO2, PO3/PSO1
CO3	PO3, PO5/PSO1
CO4	PO3, PO5/PSO1

BMEC0011:MACHINEDESIGNII

Pre-requisite:_MachineDesignI_

Objective: The objective of this course is to introduce the guidelines for design of bearings, gears, to know thedesign process of different IC engine parts like cylinder head, piston, gudgeonpin, connecting rod, crank shaftetc.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**SpurGears:**ToothForms,StandardProportionsofGearSystems,Interference,SelectionofGearMaterials,BeamStrengthofGearTooth,DynamicToothLoad,WearStrengthofGear Tooth,Failure ofGearTooth,Designof SpurGears,AGMAandIndianStandards. **Helical Gears:** Beam Strength and Wear Strength of Helical Gears, Design ofHelicalGears. **BevelGears:**StressesinBevelGears,DesignofBevelGears. **Worm Gears:** Efficiency of Worm Gears, Heat Dissipation in Worm Gearing,Strengthand WearToothLoadforWorm Gears, DesignofWorm Gearing.	18
II	**Sliding Contact Bearing:** Selection of Bearing, Hydrodynamic Lubrication,Properties and Materials, Lubricants and Lubrication, Hydrodynamic JournalBearing, Design of Journal Bearing, Thrust Bearing-Pivot and Collar Bearing,Hydrodynamic ThrustBearing. **Rolling Contact Bearing:** Classification, Bearing Life, Reliability of Bearing,SelectionofRolling Contact Bearing,Lubrication,MountingofBearing. **ICEngineParts:**SelectionofICEngine,DesignConsiderations,Designof Cylinder and Cylinder Head; Design of Piston, Piston Ring and Gudgeon Pin;Designof ConnectingRod;Design ofCrankshafts.	22

TextBooks:

- SharmaandAgrawal,"_MachineDesign_",S.K.Katara&Sons.
- Bhandari,V.B.,"_DesignofMachineElements_",TataMcGrawHillCo.

ReferenceBooks:

- Shigely,JosephE.,"_MechanicalEngineeringDesign_",McGrawHillPublications.
- Valance,AlexandDoughtie,VI,"_DesignofMachineMembers_",McGrawHillCo.
- Spott,M.F.,"_MachineDesign_",PrenticeHallIndia.
- MaleevandHartman,"_MachineDesign_",CBSPublications.
- Black&Adams,"_MachineDesign_",McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Attheendofthecourse,astudentwillbeableto

- **CO1:**UnderstandthegeartoothsystemasperAGMAstandardsSpurGear,Helicalgear,BevelGear &wormgears.
- **CO2:**AnalyzetheforceactingonSpurGear,Helicalgear,BevelGear&wormgearsusedinpowertra nsmissionapplications.
- **CO3:**SelectthematerialandevaluateofstressesforSpurGear,Helicalgear,BevelGear&wormgear sused inpowertransmissionapplications.
- **CO4:**DesignandselectionofSpurGear,Helicalgear,BevelGear&wormgearsusingAGMAstandar ds andcatalogues.
- **CO5:**Understandthecausesofbearingfailures.
- **CO6:**Understandtheselectionofhydrodynamic,hydrostaticandrollingelementbearingsusedfo r powertransmissionshafts.
- **CO7:**Designofhydrodynamic,hydrostaticandrollingelementbearingsusedforpowertransmissi onshafts.
- **CO8:**Designcylinder,piston,connecting-rodandcrankshaftsusedinICengines.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1, PO3/PSO1
CO3	PO1, PO3/PSO1
CO4	PO1,PO6,PO8/PSO1
CO5	PO2,PO3, PO4/PSO1
CO6	PO1, PO3/PSO1
CO7	PO1,PO2,PO3/PSO1
CO8	PO1,PO2,PO3/PSO1

BMEC0807:MACHINEDESIGN-IILAB

Objective: Develop and evaluate alternatives for mechanical systems. Learn programming of design problems.Apply iterative techniques in design, including making estimate of unknown values for first computation andchecking or revising and re-computing. Design Gears, Bearings and IC engine. Learn Modeling and Analysis onSoftware.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	• DesignofSpurGear • DesignofHelicalGear • DesignofBevelGear • DesignofWormandWormGear • DesignofGearAssembly • DesignofProjectReportConsistsofDifferentTypesofGears • DesignofAntifrictionBearingAssembly • DesignofJournalBearing • DesignofProjectReportConsistsofDifferentTypesofBearings. • DesignofCylinderandCylinderHead. • DesignofPiston,PistonRingandGudgeonPin. • DesignofConnectingRod. • DesignofCrankshafts. • The Design Project Consists of Two Imperial Size Sheets Drawn With3D/2D CAD Software- One Involving Assembly Drawing With A PartList and Overall Dimensions and the Other Sheet Involving Drawingsof Individual Components, Manufacturing Tolerances, Surface FinishSymbols and Geometric Tolerances Should be Specified So as to MakeItWorkingDrawing.ADesignReportGivingAllNecessaryCalculations of the Design of Components and Assembly Should BeSubmitted. Students Are Required to be Submitted A Design Report Giving All NecessaryCalculationsofthe Designof ComponentsandAssembly. DeveloptheProgramsin ‘C’LanguageforAllDesignComponents.	

TextBooks:

- SharmaandAgrawal,“*MachineDesign*”,S.K.Katara&Sons.
- Bhandari,V.B.,“*DesignofMachineElements*”,TataMcGrawHillCo.

ReferenceBooks:

- Shigely,JosephE.,“*MechanicalEngineeringDesign*”,McGrawHillPublications.
- Valance,AlexandDoughtie,VI,“*DesignofMachineMembers*”,McGrawHillCo.
- Spott,M.F.,“*MachineDesign*”,PrenticeHallIndia.
- MaleevandHartman,“*MachineDesign*”,CBSPublications.
- Black&Adams,“*MachineDesign*”,McGrawHill.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheendofthecourse,astudentwillbeableto

- **CO1:**DevelopthePrograms in MatLABLanguageforthedesignofmachinecomponentswhichinclude Gears, Bearings andI.C. enginecomponents.
- **CO2:**ModelandsimulateGears,BearingsandI.C.Enginecomponentsusedinpowertransmissionapplicationswiththeirassemblyina CADpackage.
- **CO3:**DesignandselectionofSpur,Helical,BevelandWormGears.
- **CO4:**Designofhydrodynamic,hydrostaticandrollingelementbearingsusedforpowertransmissionshafts.
- **CO5:**Designcylinder,piston,connecting-rodandcrankshaftsusedinICengines.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and ProgrammeSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2,PO5/PSO1
CO2	PO2, PO5/PSO1
CO3	PO1, PO3/PSO1
CO4	PO1,PO3/PSO1
CO5	PO1,PO3/PSO1

BMEC0012:FLUIDMACHINERY

Pre-requisite:*FluidMechanics*

Objective: Tounderstandbasicconceptof HydraulicTurbines,ReciprocatingPumpsandCentrifugal Pumpsandit'sapplicationtohydropowergeneration.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Classification of Fluid Machines & Devices, Application ofMomentumandMomentum,EquationtoFlowThroughHydraulicMachinery,Euler'sFundamentalEquation. **Impact of Jet:** Introduction to Hydrodynamic Thrust of Jet on A Fixedand Moving Surface (Flat & *C*urve), Effect of Inclination of Jet With theSurface. **HydraulicTurbines:**ClassificationofTurbines,ImpulseTurbines,ConstructionalDetails,VelocityTriangles,PowerandEfficiencyCalculations. **ReactionTurbines:**FrancisandKaplanTurbines,ConstructionalDetails, Velocity Triangles, Power and Efficiency Calculations, Degree ofReaction, Draft Tube, Cavitations in Turbines, Principles of Similarity,UnitandSpecific Speed, Performance Characteristics, Selection of Water Turbines, Governing ofTurbines.	20
II	**CentrifugalPumps:**ClassificationsofCentrifugalPumps,VectorDiagram, WorkDonebyImpellor,EfficienciesofCentrifugalPumps,SpecificSpeed,ModelTesting,Cavitations&SeparationandTheirControl,PerformanceCharacteristics. **Positive Displacement Pumps:** Reciprocating Pump Theory, Slip andCoefficient of Discharges, Indicator Diagram, Effect and Acceleration,WorkSavedbyFittingAirVessels,ComparisonofCentrifugalandReciprocatingPumps,PositiveRotaryPumps,GearPumpandVanePump, PerformanceCharacteristics. **HydraulicSystem:**HydraulicAccumulator,SpecialDutyPumps,Intensifier,HydraulicPress,LiftandCranes,TheoryofHydraulicCoupling and Torque Converters, Hydraulic Ram, Jet Pumps, Air LiftPumps.	20

TextBooks:

- Lal,Jagdish,"*HydraulicMachines*",MetropolitanBookCo.Pvt.Ltd.,2016
- Rajput, RK, "*HydraulicMachines*", S.Chand&coLtd.,2016
- Kumar,D.S.,"*HydraulicMachines*",KhannaPublishers,2010

ReferenceBooks:

- Vasandhani,V.P.,“*HydraulicMachines:Theory&Design*”,KhannaPublishers,2019
- Addison,Thomas,“*AppliedHydraulics*”,CBSPublishers,2003
- Philip, Gerhart and Wright Terry, “Fluid Machinery- application Selection and Design”, CRSPublishers,2009

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Onlearningthissubject studentswillbeableto:

- *CO1:Analyzetheforcesexerted byajetoffluid onfixed and movingvanes.*
- *CO2:Evaluatetheperformanceofmiscellaneoushydraulic machineshydraulicRam,press,intensifier*
- *CO3:AnalyzetheconstructionfeaturesandworkingprinciplesofPeltonTurbine,FrancisTurbineandKaplanTurbine.*
- *CO4:AnalyzetheconstructionfeaturesandworkingprinciplesofCentrifugaland Reciprocatingpump.*
- *CO5:Estimationofhydropowerpotentialandefficiencyof FrancisTurbineandKaplanTurbine.*
- *CO6:AnalyzetheperformancecharacteristiccurvesofFrancisTurbineandKaplanTurbine.*
- *CO7:Designandanalysisofdraft tubesusedinreactionturbines.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	PO’s/PSO’s
CO1	PO1,PO2,PO3/PSO1
CO2	PO1,PO2,PO6/PSO1
CO3	PO1,PO2,PO3/PSO1
CO4	PO1,PO2,PO12/PSO1
CO5	PO1,PO2,PO3/PSO1
CO6	PO1,PO2,PO3/PSO1
CO7	PO1,PO2,PO3/PSO1

BMEC0808FLUIDMACHINERYLAB

Objective: Tounderstandbasicconceptof HydraulicTurbines,ReciprocatingPumpsandCentrifugal Pumpsanditsapplicationtohydropowergeneration.

Credits:01 **SemesterVI** **L–T –P:0–0–2**

Module No.	Content	Teaching Hours
1	**ListofExperiments:** • DemonstrationofWorkingPrincipleoftheRunnerofPeltonWheel,Francis TurbineandKaplanTurbine. • ToFindEfficiencyandPerformanceCharacteristicsCurveofPelton Turbine. • ToFindEfficiencyandPerformanceCharacteristicsCurveofFrancis Turbine. • ToFindEfficiencyandPerformanceCharacteristicsCurveofKaplan Turbine. • ToFindthePerformanceCharacteristicsofACentrifugalPumpand ToFindItsSpecificSpeedandEfficiency. • ToFindthePerformanceCharacteristicsofAReciprocatingPump andtoFindtheSlip. • ToVerifyMomentumEquationExperimentallyThroughImpactofJetExperiment. • ToDeterminetheEfficiency ofHydraulicRam. • DemonstrationofAnyWaterPumpingStation/PlantThroughDetailedVisit. • DemonstrationofWorkingModelofHydraulicLift. • DemonstrationofWorkingModelofHydraulicBrake. • ToDesigntheImpellerofCentrifugalPumpUsingSingleArcMethodThroughAutoCad. • ToDesigntheCasingofImpeller PumpThroughAutoCad. • ToInvestigatethePerformanceofAGearPumpand toPlottheCharacteristics.	24

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Onlearningthissubject studentswillbeableto:

- *CO1:Selectahydroturbine(Peltonwheel, Francisturbine,Kaplanturbine)orapumponthebasicofavailableheadanddischarge.*
- *CO2: Determinetheforceexerted byajetoffluidonfixedand movingvanes*
- *CO3:Calculatevariousparameterslikeworkdone,efficiency,workingproportions,specificspeedofvariousturbines.*
- *CO4:Gainknowledgeaboutthedesignmethodologiesofvariouscomponentsofhydroturbineandpumps.*
- *CO5:Conductexperimentsforagivenpurposeandtoanalyzeexperimentaldataanddevelopempiricalequations.*
- *CO6:Understandtheworkingofhydraulicram,hydraulicbrake,torqueconverterandhydrauliclift.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO 1	PO1,PO2/PSO1
CO 2	PO1,PO2/PSO1
CO 3	PO1,PO2,PO3/PSO1
CO 4	PO1,PO2,PO12/PSO1
CO 5	PO1,PO2,PO12/PSO1
CO 6	PO1,PO2/PSO1

BMEC0013MANUFACTURINGSCIENCE –II

Pre-requisite:ManufacturingScienceI

Objective:In this course students acquire the ability to formulate problems in Traditional and advanced metalcuttingandevaluatethecuttingparameters,establishacompletesolutiontometalcuttingproblemsusingmathematicalor graphicaltechniques.*

Credits:03 ***L–T–P:3–0–0***

Module No.	Content	Teaching Hours
I	**Machining:** Mechanics of Metal Cutting. Geometry of Tool and Nomenclature, ASASystem, Mechanics of Chip Formation, Types of Chips. Merchant's Circle Analysis,CuttingForces,PowerRequired,ToolMaterial,ToolWearandToolLife,Machinability,Economicsofmetalcutting. **Grinding:**GrindingWheel,Abrasive&Bonds,GrindingWheelSpecifications,Grinding Wheel Wear, Attritions Wear & Fracture Wear, Dressing & Truing, SurfaceGrinding,Cylindrical Grinding&CenterlessGrinding **Machine Tools:** Working Principle, Constructions and Operations of Turret andCapstan Lathe, Tool LayOutTurretandCapstan Lathe, Shaper, Planer, Slotter,Milling,Dividing HeadandIndexing,Analysisofmaximumchipthickness,	22
II	**Additive manufacturing:**Introduction to Rapid Prototyping Technology (RPT),Rapid Manufacturing, Rapid Tooling Application and Advancement. Introduction ofSolid Based(SB),LiquidBased(LB),PowderBased(PB) RapidPrototyping. **AdvancedMachining:**WorkingPrinciple&ApplicationsofLaserBeamMachining (LBM),Electron Beam Machining (EBM), Electro chemical Machining(ECM),ElectricDischargeMachining(EDM),abrasiveJetMachining(AJM),UltrasonicMachining(USM)andPlasmaArcMachining(PAM)IntroductionofHybridMachining. **Super-Finishing Process**: Honing, Lapping & Buffing, Magnetic AbrasiveFinishing(MAF)	18

TextBook

- P.C.Sharma,"*ManufacturingTechnology(ManufacturingProcesses)*",S.ChandPublication,2006
- JainV.K.,"*AdvanceMachiningProcess*",PrenticeHall,2007.
- PPandey,HShan"ModernMachiningProcesses" McGrawHillEducation;Newedition2017
- GhoshandMalik,"*Manufacturingscience*",EastWestPvt.Ltd,2010.

ReferenceBooks:

- Boothroyd,"*FundamentalofMetalCuttingandMachineTools*",S.Chand,2017.
- JeffreyA.Hoffer"ModernMaterialsandManufacturingProcesses"PearsonEducation2007.
- SeropeKalpakjian,"ManufacturingEngineeringandTechnology(SIEdition)",2018
- P.N.Rao,"ManufacturingTechnology",Volume2|4thEMcGrawHillEducation;Forthedition,2018.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:Understand**andcomparethefunctionsandapplicationsofmetalcuttingtools,cuttingmotionsandconceptofgeneratrixanddirectrix.
- **CO2:Calculate**cuttingforces(PzandPx orPy)in straightturning atdifferentfeeds,velocitiesanddepthofcutandable toconstructMerchant'scircle diagram.
- **CO3:Recognize**chipformationmechanismandrelevantmatters(type,color&thickness)inturningmildsteelandevaluatetheroleofvariationofcuttingvelocityandfeedonchipreductioncoefficient /cuttingratioandshearangle
- **CO4:Understand**theworkingprincipleofshapingmachine,millingmachine,Capstanlathe,Turretlatheandslotter machine
- **CO5:A**pplythedifferentmetalremoving,finishingandsuperfinishingtechniquesforcomponentproduction,understandtheconceptofrapid prototypingandrapidtooling
- **CO6:Learn**thebasicconceptsapplication ofnontraditionalmachiningprocesses

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO4/PSO3
CO2	PO1,PO2,PO3/PSO3
CO3	PO1,PO3/PSO3
CO4	PO1,PO5/PSO2,PSO3
CO5	PO1/PSO3
CO6	PO1/PSO3

BMEC0809: MANUFACTURINGSCIENCE-IILAB

Objective: The purpose of this lab is to enable the students to have the practical skills manufacturing operation sand design Jig and Fixtures, Cutting Tools, Measuring Tools, Press Tools for washer making, design of a circularform tool, design the gang milling arrangement of cutters , tooth profile & tolerances for arbor, cutter & key ,twist drill to machine the holes The student will also have practical exposure to analysis the cutting forcecomponentsofatoolpointwithdesignofvarioustoolanglesand machiningvariables.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	• DesignAProcessSheetShowingMachineTool,ToolLayout,OperationElements ,Jig&FixturesUsed,CuttingTool,MeasuringTool,CuttingConditionsfortheGivenComponentsasShownintheFigure. • ToDesignALayoutofFoundryShoptoProduce/ManufactureGivenComponents. • Design A Drilling Jig for Drilling Four Holes on the Component as Shown intheFigure. • DesignASuitableMillingFixturefortheComponentShownintheFigure. • DesignAnIndexingJig/FixturefortheComponentShownintheFigure. • Design&DrawAPressTooltoProducetheComponentShownintheFigure. • Design & Draw A Press Tool Set to Produce A Washer at Each Stroke of thePress. The Washer is Made of Mild Steel 2 Mm Thick and 20 Mm is OutsideDiameter, Hole 8 Mm in Diameter. Assume Suitable Value of Shear StrengthofMaterial. • Design A Twist Drill to Machine A Hole in Cast Iron Gear Housing. The Holeis 20 Mm in Diameterby20 mm Deep and is Athrough Hole and theMachineToolisAVertical DrillPress. • Design the Gang Milling Arrangement of Cutters That You Would Providefor Machining of Faces Mark in Figure material of the Component is theCast Iron. Clearly Dimension Tooth Profile & Tolerances for Arbor, Cutter &Key. • DesignACircularFormToolfortheComponentShownintheFigure.AssumeSuitableDataWhereverNecessary&AlsoFindtheToothProfile. • The Cutting Force Components of a Tool Point While Machining on MildSteelwitha10^{0}Back RakeAngle HighSpeedSteelToolis 105Kg. IfFeedis 0.06 Mm/Rev., Depth of Cut 2.2 Mm, Design a Suitable Cross Section of theTool, Assuming the Shear Strength of the Tool Material to Be 20 Kg. /Mm^{2}and A Factor of Safety is Approximately 2.5. The Young Module of the ToolMaterial is 20x10^3 Kg. /Mm^2. If the Maximum Permissible Deflection is 0.04Mm, Find the Extent by Which the Tool Can Be Projected Out of the ToolPost. RecommendSuitableValuesofToolAngles.Give ANeat Sketchofthe DesignedTool.	

TextBook

- P. C. Sharma, "*Manufacturing Technology (Manufacturing Processes)*", S. Chand Publication,2006
- P Pandey,HShan"ModernMachiningProcesses"McGrawHillEducation;Newedition2017
- GhoshandMalik,"*Manufacturingscience*",EastWestPvt.Ltd,2010.

ReferenceBooks:

- Boothroyd,"*FundamentalofMetalCutting and MachineTools*", S. Chand,2017.
- SeropeKalpakjian,"ManufacturingEngineeringandTechnology(SIEdition)",2018
- P.N.Rao,"ManufacturingTechnology",Volume2|4thEMcGrawHillEducation;Forthedition,2018 .
- Rajender Singh, "Introduction to Basic Manufacturing Process & Workshop Technology", NewAgeInternational;Secondedition, 2010.

***Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1**:**Understand**ofdesignofvariousmachinetools,cuttingtools&measuringtoollayoutandconsiderationofmachiningvariablesat differentcuttingconditions.
- **CO2**:**Demonstrate**practicalskillsinthedesigningofpresstoolalongwithdieassemblyandtheoperationsperformedonthem.
- **CO3**:**Calculate**andoptimizethecuttingforcescomponentsofatoolpointbycuttingtool dynamometer.
- **CO4**:**Plan**andproducejobonshapingmachine,jobonmillingmachine,jobonplanerandslottermachine
- **CO5**:**Develop**amachiningprogramand processingofelectricdischargemachining.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/ PSO3
CO2	PO1/PSO3
CO3	PO1/ PSO3
CO4	PO1/PSO3
CO5	PO1/PSO3

BMEC0014: MODERN VEHICLE TECHNOLOGY (B.TECH.(AUTOMOBILEENGG.))

Objective: The course content should be taught and curriculum should be implemented with the aim to develop different types of skills leading to the achievement of the following competency:

- ***Improveefficiency,security,safety&performanceofautomobileusingelectronicsandtechnology.***

Credits:04 | **SemesterIII** | **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Applications of Transducers & Sensors:** Concept of general measurement system&differencebetweenMechanicalandelectrical/electronicinstruments;MeasurementofTemperature:WorkingofThermocoupleandThermister;Measurement of Speed: Contact less electrical tachometer, Inductive, Capacitivetype tachometer, Stroboscope; Measurement of Force: Strain gauge load cell; BasicrequirementofSensors,Functions,ApplicationsandCircuitryarrangementofvariousSensorssuchasMassAirflowratesensor,ExhaustgasOxygenconcentration, Throttle plate angular position, Crankshaft angular position, Coolanttemperature, Intake air temperature, Manifold absolute pressure (MAP), VehiclespeedSensor, RainSensor&Rainsensing wiper. **AdvanceIgnitionsystem:**Electrical & electronics ignition system.ModernSpark Ignition system (e.g. D.T.S.I , T.D.S.I., Multi electrode etc. System)Insulatedcoils.ConceptofNon-batteryEnergyStorage:Ultra capacitorsandFlywheels. **AdvancementinEngineandrelatedcomponents:**Introduction&typesofhybrid vehicle. Hybrid drives systems. Compressed air car.Solar Cars. Hydrogenoperated Engine. Basicconcepts of Blue MotionTechnologies like DSG, TSI, TDI,GDI variablevalvetiming system.	28
II	**Modernization in Peripheral systems:** Security Systems. Remote keyless entry,Anti-theft system, Alarm system. Entertainment and peripheral systems. Integratedcommunications, Proximitysensors, Globalpositioning satellites(GPS). **Advance Safety Equipments:** Seat Belts, Seat Belts pre-tensioners, Smart seatbeltReminder,ConceptsofCrashtest,Crashsensors.AirbagsIntroductionofairbags, Duelstageairbags,SideAirbags.TirepressuremonitoringsystemPedestrianProtection& Nightvisionwithpedestriandetection. **Modern Features in Automobile:** Power Sliding doors. Electronic stability / Skid-control system, Traction control system. Telescopic steering wheel / adjustablepedals.RearmountedRadar&Cameras.Electromagneticsuspensionandlevitation. Automatic Lift Axle. Regenerative Braking Systems. Continuous VariableTransmission. IntelligentParking AssistSystem,Self Parking.	21

TextBooks:

- TomDenton,‘AutomobileElectricalandelectronicsystems’,ArnoldISBN-0750662190,thirdedition,2004.
- ThareјaBL,‘FundamentalsofElectricalandElectronicsEngineering’,NirjaConstruction&DevelopmentCoLtd,NewDelhi,1984.
- PLKohli,‘AutomotiveElectricalEquipments’,TataMc-Graw Hill,NewDelhi,1983.
- A.K.SawhneyandPuneetSawhney,‘ACourseinElectricalandElectronicMeasurementsandInstrumentation’, DhanpatRai andsons,NewDelhi, 1973.

ReferenceBooks:

- JohnTurner,‘AutomotiveSensors’,Momentumpress,LLCNEWYORKISBN-9781606500095,ISBN-1606500090, 2009.
- Barbara J. Peters, George A. Peters, ‘Automotive Vehicle Safety’, SAE International and Taylor & FrancisISBN -978-0-7680-1096-1,London,2002.
- J. Marek, H.-P. Trah Sensors, ‘Automotive Technology’, Y.Suzuki, I. Yokomor / ISBN – 3527295534Wiley-vch,weinheim, 2003.
- JeffDaniels, ‘ModernCarTechnology’, JHaynes&Co. Ltd.,2009

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*
Course Outcome: ***At the end of the course, a student will be able to***
*CO1.Describeconstruction,functionsandapplicationsofvarioussensorsandactuatorsusedinmodernvehicle.**(Understand)***
CO2.*Explainmodern IgnitionsystemsofS.I.andC.I.Engines.**(Understand)***
*CO3DescribelatestadvancementinEnginetechnology.**(Understand)***
*CO4 Identifyand describevariousadvanced peripheralsystemusedinautomobile.**(Analyze)***
*CO5Demonstratevarioussafetyfeaturesand equipment usedinmodernvehicle.**(Apply)***
*CO6DescribevariousmodernfeatureslikeEBD,ABS,RegenerativeBrakingSystemetcforbetterfunctioningofvehicle.**(Understand)***

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO3,PO6,PO12/ PSO1
CO2	PO1,PO3,PO4,PO6,PO10/PSO1
CO3	PO2,PO3,PO4,PO6/ PSO1
CO4	PO2,PO3,PO4,PO6/ PSO1
CO5	PO3,PO6,PO9/PSO1
CO6	PO1,PO3,PO6,PO9/ PSO1

BMEC0015ADVANCEMATERIALSCIENCE

Objective: *Materials Science is focused on the fundamentals of biomaterials, nanomaterials, ceramics,metals,polymers,electronicmaterialsandcomposites,smartmaterials,greenandsustainablematerials emphasizing the relationships between atomic structure and microstructure as well as theproperties,processingandperformanceofthematerialinacohesiveandself-containedwaywithinthecourse.*

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**CrystallographyandImperfections:**ConceptofUnitCellSpaceLattice,Bravais-Lattices,AtomicPackingFactorandDensitycalculations,Millerindices,Imperfections,DislocationsTheory,Diffusioninsolids,Mechanicalproperties,elasticandvisco-elasticproperties **Fatigue**:Stresscycles,Factorsaffectingfatigue,crackpropagation, **Creep:**Creepcurve,stages increepcurve Stressrelaxation,DuctileandBrittlefracture,Griffiththeory,Seasoncracking **StrengtheningMechanism:**ConceptofGrainandGrainBoundary,Hall-Petchstrengthening,Solidsolutionstrengthening,precipitationstrengthening,dispersionstrengthening. **Equilibrium Diagrams:** Types of Equilibrium-Diagrams: Solid-SolutionType, Eutectic Type and Combination Type. Iron-Carbon Equilibrium-Diagram andItsImportance.	21
II	**Heat Treatment:** Various Types of Heat Treatment Such As Annealing,Normalizing,Quenching,TemperingandCaseHardening.TimeTemperatureTransformation(TTT)Diagrams. **Corrosion Science:** Definition and importance, Electrochemical reactions,Polarization,Passivity,Environmentaleffects,Eightformsofcorrosion,Cathodicprotection,Coatingsandinhibitors. High temperature materials and Materials for cryogenic applicationConcept of Magnetism and Magnetic materials, Superconductors and itstypes and phenomenon of Superconductivity, Metallic foams, Ceramics,Polymers,Composites,Carbonfibre,Graphene,NanoMaterials,Smart Materials.	23

Text Books:

- GuptaK.M.,“*MaterialsScience*”,UmeshPublication.
- RaghvanV.,“*MaterialScience*”,PrenticeHall.
- Narula,“*MaterialScience*”,TMH.
- Fontana,M.G.,“*CorrosionEngineering”*,TataMcGraw-Hill.

ReferenceBooks:

- CallisterW.D., JR,“*MaterialScience&Engineering*”,Addition-WesleyPublication.
- VlackVan,“*ElementsofMaterialScience&Engineering*”,JohnWiley&Sons.
- Avner“IntroductiontoPhysicalMetallurgy”TMHPub

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: After completion of course, the student will be able to:

- **CO1:**Understandthelimitsofmaterialsandthechange oftheirpropertieswithuse.
- **CO2:**Createanewmaterial that willhavesomedesirableproperties.
- **CO3:**Prepareadvancedcomposite materialsforspaceandmissileapplication.
- **CO4:**Optimalselectionofengineeringmaterialsthatmustsimultaneouslyfulfilldimensional,property, qualitycontrolaspects.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO3/PSO3

BMEE0001REFRIGERATIONANDAIRCONDITIONING

Pre-requisite:*AppliedThermodynamics*

Objective: TostudytheworkingofdifferentRefrigeratingandAirConditioningSystem&Analysisoftheirperformanceparameters.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Refrigeration:**IntroductiontoRefrigeration&MethodsofRefrigeration,Carnot RefrigerationCycleandItsLimitations,C.O.P. **Refrigerants:**ClassificationofRefrigerants,Nomenclature,DesirableProperties of Refrigerants, Secondary Refrigerants and CFC Free Refrigerants.GreenHouse Effect. **AirRefrigerationCycle:**OpenandClosedAirRefrigerationCycles,Reversed Carnot Cycle, Bell Coleman or Reversed Joule Air Refrigeration Cycle,Aircraft Refrigeration System, Classification of Aircraft Refrigeration System.BootStrapRefrigeration,Regenerative,ReducedAmbient,DryAirRatedTemperature(DART). Refrigerant Compressors; Classification, workdone, thermodynamic process,volumetricefficiency,principaldimensionsofreciprocatingcompressors, performancecharacteristics, **Vapour Compression System:**Single Stage System, Analysis of VapourCompression Cycle, Effect of Pressure, Sub Cooling & Superheating on C.O.P oftheCycle.Actual VapourCompressionRefrigerationCycle.	22
II	**MultistageVapourCompressionSystem**:RemovalofFlashGas,Intercooling,DifferentMultistageSystem, CascadeSystem. **VapourAbsorptionSystem:**WorkingPrincipleofVapourAbsorptionRefrigerationSystem, Ammonia– WaterVapourAbsorptionSystem, **AirConditioning:**IntroductiontoAirConditioning,PsychometricProperties and Their Definitions, Different Psychometric Processes, ThermalAnalysis of Human Body, Effective Temperature and Comfort Chart, CoolingandHeating LoadCalculations. Infiltration & Ventilation, Internal Heat Gain, Sensible Heat Factor (SHF), byPass Factor, Grand Sensible Heat Factor (GSHF), Apparatus Dew Point (ADP).ElementaryKnowledgeofTransmissionandDistributionofAirThroughDucts. **RefrigerationEquipment&Application:**AirWashers,FoodPreservation, Cold Storage, Refrigerator, Ice Plant, Water Coolers, CentralizedA.C.	21

TextBooks:

- PrasadManohar,“*RefrigerationandAirconditioning*”,NewAgeInternational(P)Ltd.Pub.
- C.P.Arora,“*RefrigerationandAirconditioning*”, TMH.
- AroraandDomkundwar,“*RefrigerationandAirconditioning*”,DhanpatRai&Co.

ReferenceBooks:

- StoeckerandJones,“*RefrigerationandAirconditioning*”,TMH.
- RoyJ.Dossat,“*RefrigerationandAirconditioning*”, PrenticeHallIndia.
- P.L.Baloney,“*RefrigerationandAirconditioning*”,SNTI,Publications.
- Kuhen,Ramsey&Thelked,“*ThermalEnvironmentEngg*”,CentralBookAgency.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:At theendofthecourseastudent will beableto

- CO1:illustrate thefundamentalprinciplesofrefrigerationandairconditioningsystems.
- CO2:understanddifferentproperties,designationandenvironmentalissuesofrefrigerants
- CO3:understandtheworkingofvapourcompressionandvapour absorptionrefrigerationsystems..
- CO4:determinethecoolingcapacityandCOPofrefrigerationsystem.
- CO5:analyzetheperformanceof psychometricprocessesusedforhumancomfort.
- CO6:determinethecoolingload/heatingloadforagivenairconditioningapplication.
- CO7:understand theworkingofIceplantandcoldstorage,airwasher.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO10/PSO1
CO2	PO1,PO7,PO12/PSO1
CO3	PO1,PO10/PSO1
CO4	PO1,PO4,PO10/PSO1
CO5	PO1,PO4,PO6,PO10/PSO1
CO6	PO1,PO4,PO10/PSO1
CO7	PO1,PO10,PO12/PSO1

BMEE0170REFRIGERATIONANDAIR-CONDITIONINGLAB

Objective: Tomakestudentsfamiliarwiththevariousdevicesassociatedwith Refrigeration&Air-Conditioning.Theexperimentsaredesignedtoprovideexposureofpracticalaspectsofthevarious theoreticalconceptsdevelopedduringtherefrigerationandairconditioningcourse.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	List ofExperiments: • ToStudyBasicComponentsofAir-ConditioningSystem. • ExperimentonRefrigerationTestRigandCalculationofVariousPerformanceParameters. • ToStudyDifferentTypesofExpansionDevicesUsedinRefrigerationSystem. • ToStudyDifferentTypesofEvaporatorsUsedinRefrigerationSystems. • ExperimentonAir-ConditioningTestRig&CalculationofVariousPerformanceParameters. • ToStudyAirWashers. • StudyofWindowTypeAirConditioner. • VisitofaCentralAirConditioningPlant andItsDetailedStudy. • VisitofCold-StorageandIts Detailed Study. • ExperimentonIce-Plant toFind OuttheCapacityofPlant. • Experiment on Two Stage Reciprocating Compressor forDetermination ofVolumetric Efficiency,PVDiagram. • StudyofCompressors- HermeticallySealed. • ExperimentonDesertCoolers. • StudyofCentralAir-ConditioningSystems	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Oncompletionofthelabstudentswillbeableto

- CO1:illustratethefundamental workingprinciples ofvapourcompressionrefrigerationsystem.
- CO2:recognizethecomponents(expansiondevices,evaporators,condensers,compressors)andunderstandtheiruseinrefrigerationsystem.
- CO3:illustratetheworkingofvapourcompressionandvapourabsorptionrefrigerationsystems.
- CO4:analyzetheperformanceparametersofvapourcompressionandvapourabsorptionrefrigerationsystems.
- CO5:analyzetheperformanceof psychometric processesusedinairconditioning.
- CO6:developprototypemodel ofrefrigerationsystemusedinIceplants,airwasher.
- CO7:determinethecapacityofwindowand splitairconditioningsystem.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO10/PSO1
CO2	PO1,PO10,PO12/PSO1
CO3	PO1,PO10/PSO1
CO4	PO1,PO4/PSO1
CO5	PO1,PO4,PO6,PO9,PO8,PO10/PSO1
CO6	PO1,PO4,PO10,PO12/PSO1
CO7	PO1

BMEE0002INTERNALCOMBUSTIONENGINE

Pre-requisite:*AppliedThermodynamics*

Objective: The objective of this course is to give an introduction of internal combustion engines with emphasison their engineering applications. The focus is on explaining engine performance in terms of power, energyutilizationandexhaustemissions,itsrelationtointernalprocesseslikecombustionandva ryingengineoperatingconditions.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to I.C. Engines**: Engine classification and basic terminology,Two and four stroke engines, SI and CI engines, Valve timing diagram, Engineperformanceparameter.ThermodynamicanalysisofAirstandardcycles,Ottocycle,Dieselcycle,Dualcycle,ComparisonofOtto,DieselandDualcycles. Introduction to Fuel air cycle & Actual cycle, factors affecting the fuel air cycle&Actual cycle. **SI Engines:** Combustion in SI engine, Stage of Combustion, Flame speed,Ignition delay, Abnormal combustion and its control, combustion chamberdesignforSIengines,Carburetor,Carburetion,Mixturerequirements,CarburetorsandfuelinjectionsysteminSIEngine,Ignitionsystemrequirements,Magneto andbatteryignition systems.	23
II	**CI Engine:** Combustion in CI Engines, Ignition Delay, Knock, AbnormalCombustion, Combustion chamber design of CI engines, Fuel Injection SystemofCIEnginesandTheirComponents, Injection Timings. **Fuels:** Fuels for SI and CI engine , Important qualities of SI and CI enginefuels, Rating of SI engine and CI engine fuels, Gaseous fuels, LPG, CNG, Biogas,AlternativefuelsforICengines,NormslikeEuroandBharatNorms. **Supercharger&Turbocharger***:*Introductiontosuperchargerandturbocharger,TypesofSuperchargingMethods,CalculationofSupercharger. BasicConceptsofAdvancedEngines.	22

Text Books:

- Mathur&Sharma,"*ACourseinInternationalCombustionEngines*",DhanpatRai&Sons.
- R.Yadav,"*I.CEngine*",CentralPublishingHouse,Allahabad.
- Ganeshan,"*I.CEngine*",TataMcGrawHillPublishers.

Reference Books:

- Gill,Smith&Ziurs,"*FundamentalsofInternalCombustionEngine*",Oxford&IBHPublishingCo.
- Rogowsky,"*ICEngines*",InternationalBookCo.
- E.FObert,"*I.CEngineAnalysis&Practice*",S.Chand.
- Engineering Fundamentals ofInternalCombustionEngines byW.W. Pulkrabek,PearsonEducation.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:**Recognize and understand the reasons for differences among operating characteristics of differentenginetypesanddesigns.
- **CO2:** Analysis of different power cycle of internal combustion engines using ideal gas cycles, air cycles,and fuel-aircycles.
- **CO3:** Characteristic of homogeneous combustion in SI-engines and spray combustion in CI-engines. FuelqualityrequirementsofSI-andCI-engines.
- **CO4:**Fueleconomytrends withitshistoryandnorms.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO3,PO4/PSO3

BMEE0003:AUTOMOBILEENGINEERING

Pre-requisite:InternalCombustionEngine

Objective: Tomakestudentawareofbasicknowledgeofautomobilesystemsandsubsystems.To makestudents aware of maintenance and overhauling of a vehicle. To show students how various system and sub-systeminvehicleworkstogether.Totellstudentsaboutlatestdevelopmentinthefieldofautomobileengineering.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Power and Transmission System:**Power and Torque Characteristics,RollingResistance,AirResistance,GradientResistance,TractiveEffortonPowerofAutomobile,ConceptofGearRatio,GearBoxandTheirTypes,SelectorMechanismofGearBox.RequirementsofGoodTransmissionSystems,ClutchesandTheirTypes,OverDriveandFreeWheel,TorqueConvertersDifferentialGearMechanism,AutomaticTransmissionandItsComponents, Propeller Shaft, Slip Joints, Universal Coupling, Final Drive andtheirTypes,AdvancesinTransmissions. **VehicleHandlingandControlSystem:**TypesofSteeringMechanism,SteeringGeometry, Working ofElectrical&HydraulicPowerSteering.	20
II	**Vehicle Handling and Control System:**. Requirement of Braking System,VariousTypesofBrakingSystem,AntiLockingBrakingSystem,EBD(ElectronicBreakingForceDistribution).FrameandTheirTypes,LoadonFrame,GeometryofSuspensionSystem,Dampers,VariousTypesofSuspensionSpringsTypesofFrontAxleIndependentSuspensionSystem.AdvancesinVehicleHandling&ControlSystem. ***Electrical System:*** Types of Ignition System Used in Automobiles and TheirWorking, Alternator, Battery, Starting Motor, Lighting System, Horn, Relays,WindscreenWiper,SpeedometerEtc. ***Cooling & Lubrication System:*** Requirements, Various Components, Types ofCoolingandLubricationSystems, HeatingandCoolingUnitofAutomobiles. Features,TechnicalSpecifications,AdvancesinAutomobileEngineering.	20

Text Books:

- **JainK.K.**and**Asthana.R.B**,“AutomobileEngineering”Tata McGraw HillPublishers,NewDelhi, 2002.
- **SinghKripal,**“*AutomobileEngineering*”,Vol.1&Vol.2,StandardPublisherNewDelhi,2007.
- **K.M.Gupta**, AutomobileEngineering,Vol. 1&Vol.2,UmeshPublications.NewDelhi,2001.
- **NakraCP**, BasicAutomobile, DhanpatRaiPublicationCo.Ltd7thEdition2005.

Reference Books:

- JosepeHeitnerAutomotiveMechanics–PrincipleandPractice,EastWestPress2ndedition1999
- CrouseW andAnglinD, AutomotiveMechanics, TataMcgraw HillPublicationltd10th edition2004

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: ***Attheendofthecourse,astudentwillbeableto***

CO1. Understand and explain the effects of Resistance forces on the power of an automobile**.(Understand)**

CO2.DescribefunctioningofTransmissionsystem, conventional and non-conventional drives,Clutches,Gearboxes,Synchromeshdevice,Propellershaft,Differentialaxle,Overdrive,Freewheel**..(Understand)**

CO3.Understandtheconceptoffiringorderformulti-cylinderenginesforignitingoffuels. **(Apply)**

CO4.Describefunctioningofsteeringsystem,steeringgeometrywheelalignmentandwheelanglesformodernAutomobile.**(Understand)**

CO5.Demonstrateandexplainvarioustypesofsuspensionsystem,brakingsystemandnewsafetysystem foranautomobilelikeEBD, ABS.**(Apply)**

CO6.UnderstandtheimportanceofelectricalsystemsinAutomobileandnumberofsubsystemslikestartingsystem,Chargingsystem,Alternators.**(Understand)**

CO7.Developconceptanddefineworking ofAutomobileEnginecoolingandlubricationsystem.**(Understand)**

MappingofCourseOutcomes(Cos)withProgram Outcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO4/PSO1
CO2	PO1,PO3,PO4,PO6,PO10/ PSO1
CO3	PO2,PO3,PO4,PO6/ PSO1
CO4	PO1,PO2,PO3,PO4,PO6,PO12/ PSO1
CO5	PO3,PO6,PO9/PSO1
CO6	PO1,PO3,PO6/PSO1
CO7	PO1,PO3,PO6,PO12/PSO1

BMEE0171:AUTOMOBILEENGINEERINGLAB

Objective: The main objective of this lab is to make students aware of various systems like braking system,Steering system, suspension system and electrical system of a vehicle. This lab is also dedicated to engine testingand performance in which various parameters of engine are calculated. Working of some new and moderntechnologylikeautomatictransmissionandMPFIisalsodemonstratedtothestudents.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	ListofExperiments: • Performance Analysis of Four Stroke S.I. Engine- Determination ofIndicated and Brake Thermal Efficiency, SpecificFuel ConsumptionAtDifferentLoads, andPreparationofEnergyBalanceSheet. • DeterminationofIndicatedH.P. ofI.C. EnginebyMorseTest. • Performance Analysis of Four Stroke C.I. Engine- Determination ofIndicated and Brake Thermal Efficiency, SpecificFuel ConsumptionAtDifferentLoads,andPrepareEnergyBalanceSheet. • ToStudytheWorkingPrincipleof GearBoxes. • TroubleShootingonDifferentialGearMechanismofRearAxle. • MeasurementofSteeringGeometryAnglesandTheirImpactonVehiclePerformance.. • TroubleShootingonAutomobileBrakingSystem. • TroubleShootingonIgnitionSystemofI.C. Engine. • Trouble Shootingon Fuel Supply System ofS.I.Engines-Carburetor,FuelInjectionPumpandMPFI. • TroubleShootingonFuelSupplySystemofC.I.Engines-Injector&FuelPump. • StudyofAirConditioningSystemofanAutomobile.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Studentshavestudiedabout:

Attheendofthecourse,astudent willbeableto

CO1.The student will be able to perform Brake Performance test analysis of Four Stroke S.I & C.I Engine and willbeabletodiagnosethefault. **(Apply)**

CO2.Thestudentwillbeabletounderstandtheroutineservicing,testingandtroubleshooting,overhaulingofaclutchandgearboxassembly.**(Analyze)**

CO3.ThestudentwillbeabletounderstandtroubleshootingonFuelSupplySystemofS.I&C.IEngines.

(Understand)

CO4.ThestudentwillbeabletounderstandthefunctioningofIgnitionSystem&BrakingSystemofI.C.Engine.

(Understand)

CO5.ThestudentwillbeabletodetermineIndicatedH.P.ofI.C.EnginebyMorseTest.**(Apply)**

CO6.TheStudentwillbeabletoperformminorandmajortuningofgasolineanddieselengines.**(Analyze)**

MappingofCourseOutcomes(Cos)withProgramOutcomes (Pos)andProgramSpecificOutcomes(PSOs):

COs	***POs/PSOs***
CO1	***PO2,PO3,PO4,PO6/PSO1***
CO2	***PO3,PO6,PO9/PSO1***
CO3	***PO1,PO2,PO4,PO10/PSO1***
CO4	***PO1,PO2,PO3,PO4,PO6,PO12/PSO1***
CO5	***PO2,PO3,PO6,PO9/PSO1***
CO6	***PO3,PO4,PO6,PO9/PSO1***

BMEE0004POWERPLANTENGINEERING

Pre-requisite: *AppliedThermodynamics*

Objective: Tomakestudentconversantwith variouscomponentsandoperationsofdifferentpowerplantsandpowerplanteconomics..

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** The Sources of Energy, Development of Power Generation inIndia,RankingCycle,Reheat.Regeneration. **Power Plant Economics and Environmental Considerations**:Costsofpowergeneration,GeneralArrangementofPowerDistribution,LoadCurves, Load Duration Curve, Economic Scheduling, Definitions of ConnectedLoad,MaximumDemand,DemandFactor,AverageLoad,LoadFactor,DiversityFactor–RelatedExercises. **EffluentsFromPowerPlant:**ImpactonEnvironment,PollutantsandPollution Standards,MethodsofPollutionControl. **Steam Power Plant**: Plant Layout, Working of Different Circuits, Types ofcoal, Coal Handling, Dust and Ash Handling Systems.**Combustion Process:** Coal Stokers, Pulverized Fuel Burning System and ItsComponents,CombustionNeeds andDraughtSystem,CycloneFurnace. Feedwatertreatment,PlantAuxiliaries**.**	20
II	**HydroElectricPowerPlant**:HydrologicalCycle,Hydrographs,.PlantClassification, Typical Layouts, Plant Auxiliaries, Classification of Dams andSpillWays, PlantOperation. **NuclearPowerStation**:NuclearFuels,NuclearReactors,ReactorOperation.PressurizedWaterReactor,BoilingWaterReactor,Sodium-Graphite Reactor, Fast Breeder Reactor, Homogeneous Reactor, Gas CooledReactor,RadiationHazardsandShielding–RadioactiveWaste Disposal. **Gas Turbine Plant**: Introduction, Classification, Construction – Layout WithAuxiliaries, Principles of Working of Closed and Open Cycle Gas power plant.CombinedCycle PowerPlantsandComparisons. **PowerFromNon-ConventionalSources**:Solarenergy.WindEnergybasedpowerplant-PrincipleofWorking,,MHDpowerGeneration.	22

Text Books:

- P.K.Nag,"*PowerPlantEngineering*":TataMcGraw-HillPublishingCompany,Ltd.
- P.C.Sharma"*PowerPlantEngineering*",S.K.Kataria Pub.

Reference Books:

- M.M.ElWakil,"*Power PlantTechnology*":TataMcGraw- HillPublishingCompany,Ltd.
- A.J.WoodandB.F.Wollenberg"PowerGenerationOperationandControl":Wiley.

- G.D.Rai,“Non-ConventionalEnergySources”:KhannaPublishers.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Afterthecompletion ofcourse,Students willbeableto:

- CO1:describethelayoutandcomponentsofthermalpowerplant.
- CO2:analyzetheperformanceof thermalpower plant basedontheRankincycle.
- CO3:describethelayoutandcomponentdetailsofhydroelectricpowerplant.
- CO4:describethelayout,componentdetailsofgaspowerplantandnuclearpowerplant.
- CO5:analyzetheperformanceof gaspower plantbasedontheBraytoncycle.
- CO6:understandthebasicprinciplesofeconomicsofpowergenerationandenvironmentalhazardsofpowerplants.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO10,PO12/ PSO1
CO2	PO1,PO2,PO4/PSO1
CO3	PO1,PO10/ PSO1
CO4	PO1,PO6,PO7,PO10/PSO1
CO5	PO1,PO2,PO4/PSO1
CO6	PO1,PO7,PO10/PSO1

BMEE0005GASDYNAMICS

Pre-requisite:*AppliedThermodynamics*

Objective: The main objective of the course is to provide an insight into the applications of compressible flowand to enable the students formulate and solve problems in one dimensional steady compressible flow includingisentropic nozzle flow, constantareaflowwithfriction or with heattransfer.

Credits:04 **L–T–P:3–1–0**

Module No.	Content	TeachingHours
I	**Basics of Fluid Mechanics**: Conservation laws for mass and Momentum,Velocity of sound, Bulk modulus of elasticity, Coefficient of Compressibility,Stagnation state, Critical state, Various regions of flow, Differences betweenIncompressibleandCompressibleflows,Reynoldsnumberanditssignificance.**Fundamentals of compressible flow:** Objective and applications ofcompressible flow, Ideal gas relationship, The adiabatic energy equation,Physical significance of Crocco number and Mach number, Characteristic Machnumber, Critical Mach number, Mach waves, Mach cone and Mach angle, staticand stagnation states, relationship between stagnation temperature, pressure,density and enthalpy in terms of Mach number, stagnation velocity of sound,reference speeds, various regions of flow, Effect of Mach number oncompressibility, Area velocityrelationship. **Isentropic flow through a variable area duct**: General features of isentropicflow, performance curve, Comparison of adiabatic and isentropic process, Onedimensionalisentropicflow inductsofvaryingcross-section-nozzlesanddiffusers, operation of nozzles under varying pressure ratio, Mach numbervariation, Area ratio as a function of mach number, Impulse function, Massflowratethroughnozzlesanddiffusers,Phenomenonof choking,subsonic and supersonicdesigns.	22
II	**Flowthrough constantareaductswithfriction:**Objective,outcomeandassumptions of Fanno flow,Fanno curves, Equation andits solution,Variationofflowpropertieswithductlength.Isothermalflowwithfriction, Variationofflow properties. Tables and charts for Fanno flow. Applications of Fanno flow.**Flowthroughconstantareaductswithheattransfer**:Rayleighflow,Rayleighflowequation,Rayleighline,Variationofflowproperties,Maximumheattransfer. Basic formulation of non Isothermal flow with heat transfer and friction**Normal Shock Gas Dynamics:** Development of shock wave, governingequations,Prandtl–Meyerrelation,RankineHugoniotrelation,Impossibilityofrarefaction shock, Mach number downstream of shock, Property variationacrossshock,Strengthofshockwave,entropychange,supersonicdiffuser. NormalshocksinFannoandRaylighflow.Introductiontoobliqueshockflow.	21

Text Books:

- *1.FundamentalofCompressibleflow,S.M.Yahya,NewageinternationalPublication,Delhi*
- *2.Fundamentalsofcompressiblefluiddynamics-P.Balachandran,PHILearning,NewDelhi*
- *3.GasDynamics,E.Rathakrishnan,PHILearningPvt. Ltd*

Reference Books:

- *1.ThedynamicsandthermodynamicsofCompressiblefluidlowVolume-I,AscherH.Shapiro,theRonaldPressCompany,NewYork.*
- *2.GasDynamicsandJetPropulsion-P.Murugaperumal,ScitechPublication,Chennai.*
- *3.ModernCompressibleFlow:WithHistoricalPerspective,JohnD.Anderson,McGraw-HillHigherEducation*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:**Conceptsandresultsforthecompressibleflowofgasesandintroductiontothenumericalmethodof characteristics.
- **CO2:**Conservationlaws,propagationofdisturbances,isentropicflow,compressible flowinductswithareachanges, normal and obliqueshockwavesandapplications.
- **CO3:**Prandtl-Meyerflow,FannoflowandRayleighflowwithapplicationstonozzlesandonedimensionalunsteadyisentropic flow
- **CO4:** physicalunderstanding ofthe phenomena andbasicanalyticalresults.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO3/PSO3
CO4	PO2,PO4/PSO3

BMEE0006 GASTURBINEANDJETPROPULSION

Pre-requisite:*AppliedThermodynamics*

Objective: Students will be able to understand propulsion systems in aircraft that are essential to graduateengineers who are intended to work in aircraft system/component manufacturing/maintenance environments.Students should be able todescribe thekeyaeronautical engineering featuresin the contextofwhichtherelevant industryoperates.

Credits:04 **L–T–P:3–1–0**

ModuleNo.	Content	TeachingHours
I	**IntroductiontoGasTurbine:**SimplegasturbineandreviewofBraytoncycle. **CycleArrangements:**Opencyclearrangement,closedcyclearrangement. Basicrequirementsofworkingmediumanditsproperties. **Idealcyclesandtheiranalysis:**Simplegasturbinecycle,heatexchange cycle, reheat cycle, intercooled cycle, combinations of variouscycles,comparisonof variouscycle. **Impulseturbineandreactionturbines:**Introductiontoimpulseturbineandreactionturbines,Multistagemachine,compoundingofturbines.	22
II	**Elementary turbine design:** Velocity triangleofsinglestageturbine,Expressionforworkoutput,bladeloadingand flowcoefficients,bladeand stage efficiencies, Blade to gas speed ratio, losses and efficiencies.**Aircraft Propulsion:** Introduction, types ofaircraftenginesandtheiranalysis(gasturbineengines,turbojetengines,turbofanengines,turbopropengines) **Aircraftpropulsiontheory:**Thrust,thrustpower,propulsiveefficiency,ram efficiency,thermalefficiencyandoverallefficiency.	23

TextBooks:

- CohenandRogers,'GasTurbineTheory',DorlingKindersley(India)pvt.Ltd.,Noida.
- V.Ganesan,'GasTurbines',TataMcGrawHills,NewDelhi.
- S.M.Yahya,'Turbines,Compressorsandfans',McGrawHills,NewDelhi.

ReferenceBooks:

- JackD.Mattingly,'ElementsofGasTurbinePropulsion',TataMcGrawHills,NewDelhi.
- Mathurand Sharma,'GasTurbineandJet&RocketPropulsion',Standardpulishers,Delhi.
- AhmedandSayed,'AircraftpropulsionandGasTurbineEngines'CRCpress,TaylorandFrancis.

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:**Outlinegoverningequationsofcompressiblefluidflow.
- **CO2:**Analyzeonedimensionalcompressibleflowthroughvariableareaduct.
- **CO3:**Analyzecompressibleflowhavingnormalshock.
- **CO4:**Applygoverningequationstocompressibleflowthroughconstantareaduct withfriction.**CO5:**Applygoverningequationstocompressible flowthroughconstantareaductwithheattransfer.
- **CO6:**Interpretpropulsivesystemsfortheir workingandapplication.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO4/PSO3
CO4	PO2,PO4/PSO3
CO5	PO2,PO3/PSO3
CO6	PO3,PO4/PSO3

BMEE0007 ADVANCEDHEATTRANSFER

Pre-requisite:*Heat&MassTransfer*

Objective: *Todevelop theunderstanding ofstudents tosolve the reallife applicationsbyapplyingthelawsofheattransfer.Analysisofheattransfermechanismsincombined modesofheattransfer.*

Credits:04 **L–T–P:3–1–0**

ModuleNo.	Content	Teaching Hours
I	TransientHeatConduction,Convection,NumericalSolutionofConductionproblemsandMassTransfer,Finitedifferenceequations method of energy balance, finite difference formulationof unidirectional for Cartesian cylindrical coordinate of variouskindofboundaryconditions,heatconductionproblems,numerical methods of solutions, numerical solution of transientheatdiffusionproblems.EmpiricalcorrelationsofFreeandforcedheat transfer. Heat exchanger heat transfer problems. Thermalboundarylayer thickness.	22
II	Convectivemasstransferequationsandtheirapplications.Boundarylayermasstransferempiricalcorrelationsforconvectivemasstransfer. Heat Transfer by Radiation, Boiling and Condensation, nucleatepoolboilingandempiricalcorrelationsforpoolboilingheattransfer, factors affecting pool boiling film coefficients, high heatfluxboiling.Laminarfilmcondensationonaverticalplate,turbulentfilmcondensation,dropswisecondensation.	23

Text Books:

- J.P.Holman“HeatTransfer”Mac-GrawHillspublication,2017
- YadavR.,“*HeatTransfer*”,CentralPublishingHouse,Allahabad,2018

Reference Books:

- Bayazitouglu&Ozisik, “*ElementsofHeat transfer*”,T.M.H.,2015
- Pitts&Sisson,“*Schaum'soutlineofHeatTransfer*”,McGraw-HillInternationaledition,2018
- Frank Kreith,“*PrinciplesofHeatTransfer*”,McGraw-HillBookco.,2019

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

OUTCOMES: Aftercompletionofcourse,thestudentswillbe ableto:

- Determinetheheattransferthroughcompositewallof aFurnaceundergivenboundaryconditions.
- Determinethenumericalheattransferofcompositesystemundersteadystateconditionofheattransfer.
- Determinethenumericalheattransferofcompositesystemunderun-steadystateconditionofheat transfer.
- Establishempiricalrelation foragiven heattransferapplication.
- Understandmassdiffusion rateincaseofevaporativecooling incoolingtowers.
- Understandthe effectsoffoulinginboilertubesofthermalpowerplant.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO3/PSO1,PSO2
CO3	PO1,PO2/PSO1
CO4	PO1,PO2,PO3/PSO1
CO5	PO1,PO2/PSO1,PSO2
CO6	PO1,PO2/PSO1,PSO2

BMEE0008 SOLAR ENERGY

Credit:03 **L-T –P-J:3-0-0-0**

Courseobjective:

Solar energy is ultimate energy resource available on planet earth. Objective of this course is to makestudents aware about many facets of solar energy. How solar energy can be harnessed for variousapplications. Ultimate objective of this course is to train students about integration of solar energydevicesinbuildings,agriculturalandothermechanizedmeans.

Module No.	Content	Teachin gHours
I	**Introduction:**generalintroductiontorenewableenergytechnology,Solarenergypotentialin India, energy demands and renewable energy. current and future scenario.**Solarradiation**:Directanddiffusedradiation,Radiationmeasuringequipment.Basics ofsolarangles. **Solarcollectors**:basicworkingofcollectors,FPSC,PTC,Solarconcentrators, , tracking mechanism,Solar energy storage systemsdesignsandperformanceanalysisbased onstandard norms. **Applications** in water heating systems, steam generating with solarenergy.Phase changingmaterialsforenergystorage	20
II	Solarairheatingsystems,Spaceheatingandcoolingprocesses PV Systems,hybrid PV/Tsystems.Renewableenergy desalinationsystems.Energyconversionsystemsbasedonbio-mass,Photosynthesisbasic conceptandworkingoffuelcell. Active & Passive building applications. Economics (IRR, LCOE,ROI)Design,modelingand simulationofsolarenergysystems.	22
	Totalhours	**42hours**

Text Books

- S.PSukhatmeandJ.KNayak.“Solarenergy,principleofthermalcollectionandstorage”

- S. Kalogirou “Solarenergyengineering:processesandsystems.”ISBN978-0-374501-9

ReferenceBooks:

- YogiGoswami“PrincipleofSolarengineering”, CRCPress,Thirdedition.
- J.ADuffie&W.ABeckman“Solarengineering&thermalprocesses”JohnWiley&Sons,4ed.
- G.NTiwari“Solarenergy:Fundamental,design,ModelingandApplications”ISBN-10:0849324092
- C.P.Arora“Refrigerationandairconditioning”TataMcgraw-Hill PublishingCompany,2ndEd.

Outcome:

CO1.UnderstandworkingofsolarradiationmeasuringequipmentsCO

2.Determinemagnitude ofincidentradiation.

CO3. Understandworkingofsolarcollectorsystems.

CO4.Applyknowledgetodesignimprovedsolarenergybasedsystems.CO5.

Analyzeprocessesofspaceheating and coolingsystems.

CO6. Canperformmodelingandsimulationforperformanceanalysistooptimizethesystemefficiency.

CO7.Designanddevelop smallsolar energybased systemssuitableforruralareas.

MappingofCourseOutcomes(COs) withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PSO1
CO2	PO4/PSO1
CO3	PO1,PSO1

CO4	PO3,PO5,PSO1,PSO2
CO5	PO7,PO9,PO3,PSO1,PSO3
CO6	PO3,PO4,PO5,PSO1,PSO3
CO7	PO3,PO6,PO7,PO10,PO12,PSO1,PSO3

BMEE0172 SOLAR ENERGY LAB

Objective:*Todevelopthecapabilityofstudentstounderstandsolarenergyharvestingsystemsandto applyacquiredknowledgetofulfillthesocialneeds.*

Credits:01 **L–T–P-J:0–0–2-0**

Exp.No	Experimentobjectiv e	Hours
1	TodeterminethermalefficiencyofFPSCinindoorcondition	2
2	TodeterminethermalefficiencyofFPSCinnaturalmode	2
3	Todeterminethermalefficiencyofsingleaxisparabolictrough collector	2
4	TodeterminethermalefficiencyofPTC (doubleaxis)	2
5	Determinethermalefficiencyofsolarairheatingsystem	2
6	Todeterminecharginganddischargingefficiencyofenergy storagesystem.	2
7	Todetermineoverallheat transfercoefficient ofenergystorage system.	2
8	Todetermineoverallheat transfercoefficient ofFPSC.	2
9	Tostudysolartrackingsysteminparabolictroughcollector	2
10	Toanalyzethethermalperformanceofheatpipeuseinsolar collectorsystem.	2
11	Tostudyworking ofPV/Tsystemforsolarenergyabsorption	2
12	Tostudyworkingofthermalimagingcameraand itsapplication	2

Text/Referencebooks:

- “Renewableenergypowerfor sustainablefuture”,oxforduniversitypress.
- S.PSukhatmeand J.KNayak “Solarenergy,principleofthermalcollectionand storage”
- S.Kalogirou“Solarenergyengineering:processesandsystems”ISBN978-0-374501-9

Outcome:

- CO1:Tounderstandworkingofsolar radiationmeasuringequipments.
- CO2:Determine magnitudeofincidentradiation.

- CO3:Analyzeperformanceofvarioussolar collectorsystems.
- CO4:Applytheirknowledgetodesignimprovedsolarenergybasedsystems.
- CO5:Designandanalysesworkingofspaceheatingandcoolingsystems.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO4,PO5,PSO1
CO4	PO3,PSO1
CO5	PO3/PSO1

BMEE0186PROJECT BASEDSOLARENERGYLAB

Credits:02 **L–T–P-J:0–0–0-8**

Objective: Totrainandguidestudents for modeling, designandfabricationofprojectsbasedonsolarenergyharvestingandapplicationsinruralandi ndustrialsector.

1. Roleofnanofluidasaheattransferfluidinthermalenergystorageusingphasechangematerials.(Like MWCNT)
2. Experimentalinvestigationonthermalperformanceofheatpipe.
3. Experimentalphotovoltaicthermaltrainingsystemdomestictype.
4. Thermal energy storage via parabolic trough collector in high melting pointtemp.PCM.(likefattyacids)
5. Designandfabricationofflatplatesolarcollectorand investigatetheoverallefficiency.
6. Designandfabricationofparabolictroughcollectorandinvestigatetheoverallefficiency.
7. Designandfabricationofsolarairheaterandanalysisonefficiency.
8. Determinetheperformanceofparabolictroughcollectorwithfixedparametersandproperinsulationofstoragetank.
9. Designandfabricationofsolardryerandinvestigateefficiency.
10. DesignandanalysisofPV/T Solarairspaceheatingsystem.

Text/Referencebooks:

- “Renewableenergypowerforsustainablefuture”,oxforduniversitypress.
- S.PSukhatmeand J.KNayak “Solarenergy,principleofthermalcollectionandstorage”
- S.Kalogirou“Solar energyengineering:processesandsystems”ISBN978-0-374501-9

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

- CO1:Applyacquiredknowledgeindesignofbasic solarenergyapparatus.
- CO2:Applyknowledgeofbasicsciences,heatandmasstransfer,thermodynamicsina nalysisofsolarapparatus.
- CO3:Analyzeperformanceofvarioussolar collectorsystems.

- CO4:Applytheirknowledgetodesignimprovedsolarenergybasedsystems.
- CO5:Integrate/applysolarsystemsforapplicationsinspace heatingandcoolingrequirement.
- CO6:Providesolutionto ruralandurbanpeopleregardingenergysaving andutilization

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO4,PO5,PSO1
CO4	PO3,PSO1
CO5	PO3/PSO1
CO6	PO6/PSO1

BMEE-0009INTRODUCTIONTOVEHICLEDYNAMICS

Typeofcourse:
Elective(MechanicalEngineering),Advanced/Applications(AutomobileEngineering)

Pre–requisite:
KinematicsofMachines,DynamicsofMachinery(MechanicalEngineering),AutomobileSystem, Physics(AutomobileEngineering)

Objective: To understand the principle and performance of vehicle in various modes such as longitudinal,vertical and lateral directions. At the end of the course the student will be able to identify the various forces andloadsand performanceunderacceleration, rideand braking.

Credits:04 **Semester VI** **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:**IntroductiontoVehicleDynamics,LongitudinalDynamics,VehicleLoadDistribution – Acceleration and Braking - Brake Force Distribution, Braking Efficiency.**Aerodynamics:**MechanicsofAirFlowAroundaVehicle,PressureDistributionona Vehicle,AerodynamicForces,DragComponents,AerodynamicsAids.**TireMechanics:**TireConstruction,SizeandLoadRating,TerminologyandAxisSystem,TractiveProperties,Cornering Properties,CamberThrust,AligningMoment,CombinedBraking andCornering,ConicityandPlySteer,Slip,Skid	25
II	**Tire Mechanics:** Rolling Resistance, Elastic Band Model for longitudinal slip, Simplemodel for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut stringmodel for lateral slip, Magic Tire Formula. **Motorcycle Dynamics:** Kinematic structureof motorcycle, geometry of motorcycles, importance of trail, Resistance forces acting onmotorcycle(tyrerollingresistance,aerodynamicresistanceforces,resistantforcecaused byslope),Location& heightofmotorcycle'scentreofgravity(C.G),Momentsof inertiaonMotorcycle.IntroductiontoFront&RearsuspensionsofMotorcycle	25

Text Books:

- WongJY,"TheoryofGroundVehicles",JohnWiley&Sons,NewYork,1978.
- MillikenWFandMillikenDL,RacecarVehicleDynamics,SAE.
- Garrett T K, Newton K and Steeds W, "Motor Vehicle", Butter Worths & Co., Publishers Ltd., NewDelhi, 2001.

Reference Books:

- R N Jazar, Vehicle Dynamics: Theory and Application, SpringerRogowsky, "*IC Engines*", InternationalBookCo.
- HansPacejka,TireandVehicleDynamics,Elsevier,2012.
- ThomasDGillespie,"FundamentalsofVehicledynamics",SAEUSA1992.

- RajeshRajamani,VehicleDynamics&control,Springer.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome :*Attheendofthecourse,astudentwillbeableto*

CO1.Understandthedynamicsofvehicleride.

CO2.Calculateandrefertheloadsandforcesassociatedtothevehicles.

CO3.Analysethebehaviorofthevehiclesunderacceleration,rideandbraking

CO4.Understandhowpassengercomfortisachievedalongwithvehiclestability.

CO5.Understandandexplaintheeffects ofResistanceforcesonthepowerofanautomobile**.**

CO6.Abilitytounderstandaboutsuspensionandtyrerelatedvibrations.

MappingofCourseOutcomes (Cos)withProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs) :

COs	*POs/PSOs*
CO1	*PO1,PO2,PO3,PO4/PSO1*
CO2	*PO3,PO6,PO9,PO10/PSO1*
CO3	*PO2,PO3,PO4,PO6/PSO1*
CO4	*PO1,PO2,PO3,PO4,PO6,PO12/PSO1*
CO5	*PO1,PO3,PO6/PSO1*
CO6	*PO1,PO3,PO6,PO12/PSO1*

BMEE0173VEHICLEDYNAMICSLAB

Credits:01 **L–T–P-J:0–0–2-0**

- Experimentalstudyofmechanismforairflowoverdifferentgeometryofvehicles.
- Experimentalstudiesofmeasurementsofdragandliftcoefficientfordifferentgeometryvehicleusingwind tunnel apparatus.
- Tostudytheeffectoftyrepressure andtemperatureontheperformanceofthetyre.
- Tosimulateand studyaquartercarmodelsusingMBDsoftware.
- Tosimulateandunderstandbehaviourofsprung/un-sprungmass&lumpedmasssystemMBDsoftware.
- Findingthestiffnessoftyrewithvariationofairpressure.
- Tosimulateand studythe effectofdifferentconditionson vehicleloading.
- Studyoflatesttechnologiesavailablenowadaysinvehicleshelpingtomaintainstabilityof thevehicleontheroad.
- Studygeometryofmotorcyclesaswellasvarioustypesofforcesfacedbythemotorcycle &its rider
- Studythelocation&heightofCentreofgravity(C.G)ofamotorcycle

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome: Attheendofthecourse,astudentwill beableto

CO1.Thestudentwill beabletodeterminetheeffectsofairflow overdifferentgeometryofvehicles.

(Apply)

CO2.The student will be able to determine coefficient of drag and lift for different vehicle geometrybyusingwindtunnel apparatus.**(Analyze)**

CO3.The student will be able to understand quarter car models and Behaviour of sprung / un-sprungmass&lumpedmasssystem.**(Understand)**

CO4.The student will be able to understand geometry of motorcycles as well as various types offorcesfacedbythemotorcycle&its rider.**(Understand)**

CO5.The student will be able to understand geometry of motorcycle and various forces effect onvehicleanditsrider. **(Understand)**

CO6.TheStudentwill beable to locateandfindheightofCentreofgravity (C.G)ofamotorcycle.

(Analyze)

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs) :

COs	***POs/PSOs***
CO1	***PO2,PO3,PO4,PO6/PSO1***
CO2	***PO3,PO6,PO9/PSO1***
CO3	***PO1,PO2,PO4,PO10/PSO1***
CO4	***PO1,PO2,PO4,PO10/PSO1***
CO5	***PO1,PO2, PO3,PO4,PO6,PO12/PSO1***
CO6	***PO3,PO4,PO6,PO9/PSO1***

BMEE0101:ADVANCEDFLUIDMECHANICS

Objective: Aims to give Mechanical Engineering students a deeper and more thorough grounding in principlesand basic applications of fluid mechanics. Topics include: reviewof the conservation principles;constitutive relations of Newtonian fluid; Navier-Stokes equation; inviscid flow – inertial propertiesofvortex,2Dpotentialflows;viscousflow–basiclaminarflows,boundarylayertheories;introduction toturbulentflow –flow separation,sourcesofdrag.

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Basic Concepts and Fundamentals:** Definition and properties of Fluids,Fluid as continuum, Langragian and Eulerian description, Velocity and stressfield, Fluidstatics,FluidKinematics **GoverningEquationofFluid Motion:**Reynoldstransporttheorem,Integral and differential forms of governing equations: mass, momentum andenergyconservationequations,Navier-Stokesequations,Euler'sequation,Bernoulli'sEquation. **Exact Solution of Navier – Stokes Equation:** Couette flows, Poiseuilleflows,Fullydevelopedflowsinnoncircularcross-sections,Unsteadyflows,Creepingflows. **Potential Flows:** Revisitof fluidkinematics,Stream andVelocitypotentialfunction, Circulation, Irrotational vortex, Basic plane potential flows: Uniformstream;SourceandSink;Vortexflow,Doublet,Superposition ofbasicplane potential flows, Flow past a circular cylinder, Magnus effect; Kutta-Joukowski lifttheorem;Conceptof liftanddrag.	20
II	**LaminarBoundaryLayer:**Boundarylayerequations,Boundarylayerthickness, Boundary layer on a flat plate, similarity solutions, Integral form ofboundarylayerequations,ApproximateMethods,Flowseparation,Entryflowintoa duct. **Turbulent Flow:** General equations of turbulent flow, Turbulent boundarylayer equation, Flat plate turbulent boundary layer, Turbulent pipe flow, Prandtlmixinghypothesis,Turbulencemodeling,Freeturbulentflows. **Compressible Flow:** Speed of sound and Mach number, Basic equations foronedimensionalflows,Isentropicrelations,Normal-shockwave,RankineHugoniotrelations,FannoandRayleighcurve,Machwaves,Obliqueshockwave, Prandtl-Meyerexpansionwaves,Quasionedimensionalflows,Compressibleviscousflows,Compressibleboundarylayers.	21

Text Books:

- GuptaVijayandGuptaS.K.,"FluidMechanicsanditsApplications",WileyEasternLtd,1984.
- Som,S.K.&BiswasG.,"Introductionoffluidmechanics&FluidMachines",TMH,2000,2ndEdition

- Shames, I.H.,“MechanicsofFluids”, McGrawHill, Int.Student,Education, 2016
- FrankM.White,ViscousFluidFlow,ThirdEdition,McGraw-HillSeriesofMechanicalEngineering,2006

Reference Books:

- Fox W.Robert,McDonald T.Alan,Introduction toFluidMechanics,Fourth Edition,JohnWiley&Sons,1995
- MuralidharK.andBiswasG.,AdvancedEngineeringFluidMechanics,SecondEdition,Narosa,2005.
- SchlichtingH.,BoundaryLayerTheory,SpringerVerlag,2000.
- McCormack,P.S.&Crane,L.J.PhysicalFluidDynamics, AcademicPress,1973

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: *Onlearningthissubject,studentswillbeableto:*

- *CO1:Applythefundamentalsofkinematics,dynamicsandconservationlawsoffluidflowsystems.*
- *CO2:Apply theprinciplesofhighand lowReynoldsnumberflowstofluidflowsystems.*
- *CO3: Reviewtheconceptsofboundarylayerandflowin transition.*
- *CO4:Apply thefundamentalsofturbulentflowtovariousfluidflowsystems.*
- *CO5: Applythefundamentalsofonedimensional isentropicflowtovariablearea duct.*
- *CO6: Analysetheconcept of normal shockformation and itseffects.*
- *CO7:Applythe principlesofcompressible flowtoconstantareaductsubjectedtofrictionor heattransfer*

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2/PS1
CO4	PO1,PO2,PO3/PS1
CO5	PO1,PO2/PS1

CO6	PO1,PO2,PO12/PS1
CO7	PO1,PO2,PO12/PS1

BMEE-0102COMPRESSIBLEFLUIDFLOW

Prerequisites:_AdvancedFluidMechanics_

Objectives: The objective of this course for post graduation students is to provide a solid background onthepertinentmathematical,physical,andengineeringconceptsthatmakeupthefoundationsof thecompressible flows.

Credits:04 **L-T-P:3:1:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**BriefReviewofFluidMechanicsandThermodynamics:**Introduction,Dynamics Lawsofmotion,Kinematics,Equationofmotion,Reviewofthermodynamics, concepts of entropy and vorticity, Ideal gases, Special formsof the governing equations, Transport properties. **Physical Acoustic & Natureof Steady Compressible Fluid Introduction,**Onedimensionwavemotion,Transportofenergy& momentum, propagation of sound in duct, Machnumber,InviscidEnergyequation,PotentialFlow,Isentropicflow.**OneDimensional Steady Flow:** Introduction, Isentropic flow of perfect gases induct,Flowwithfriction,Flowwithheataddition,Flowwithfrictioninaconstantarea pipe.	25
II	**OneDimensionalUnsteadyFlow**:Shock conditions, the properties ofshock waves, weak & strong shockapproximation, Characteristicequationsfor homentropic &isentropicflow, Method of characteristics,piston analogy, Detonations and deflagrations. **Two Dimensional Steady Flow**Prandtl-Mayer function, Method of characteristics, Obliqueshocks,shockpolar,Reflectedandintersectingshocks,expansion waves,Curvedshocks,Nozzledesign,Linearizedpotentialflow,thinairfoilandslenderbodytheories,Conicalflow,Transonicflow.**ViscousEffects&AnalogsofCompressibleFlow**:Compressibleboundarylayers,Shockthickness,Shockwave-boundarylayer interactions, Shallow water flow, Trafficflow, Electro-acousticalanalogy	25

TextBooks:

- *BalachandranP.,FundamentalsofCompressibleFluidDynamics,PHILearning.2006*
- *RathakrishnanE.,GasDynamics,PHILearning,2014*
- *YahyaS.M.,FundamentalsofCompressibleFlowwithAircraftandRocketPropulsion,NewAgeInternationalPublishers,2003*

ReferenceBooks:

- *Anderson,Moderncompressibleflow,3eMcGrawHillEducation,2012.*
- *Shapiro,DynamicsandThermodynamicsofCompressibleFlow –Vol1.,JohnWiley&Sons,1953*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: ***Attheend ofthecourse, a studentwillbeableto***

CO1. Formulate and solve problems in one -dimensional steady compressible flow including: isentropic nozzleflow, constant area flow with friction (Fanno flow) and constant area flow with heat transfer (Rayliegh flow)**.(Analyze)**

CO2.Derivetheconditionsforthechangeinpressure,densityandtemperatureforflowthroughanormalshock**.**

(Apply)

CO3.Determinethestrength ofobliqueshockwavesonwedgeshapedbodiesand concavecorners. **(Determine)**

CO4.Understandthevariousmeasuringinstrumentsusedincompressibleflow.**(Understand)**

CO5.Understandtheeffectofviscosity&analogyofcompressibilityon boundarylayerformation.**(Understand)**

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3,PO5/PSO1
CO2	PO1,PO2,PO3/PSO1
CO3	PO2,PO3,PO3/PSO1
CO4	PO1,PO3,PO5/PSO1
CO5	PO1,PO3,PO5/PSO1

MEE0103AERODYNAMICS

Objective:

Students will be able to understandthe determination of forces, moments considering the thermal effects (heattransfers)on the bodies moving in a fluid.They will also learn the movement of wings or use of the wind force, thiswayitrequiresthecalculationstobedonefortheaerodynamicheatingoftheflightvehiclesand thehydrodynamic forcesapplied onthesurfaceofthevehicle.

Credits:04 **Semester** **L–T–P:3–1–0**

ModuleNo.	Content	Teaching Hours
I	**Introduction:**Airfoils,wingsandtheirnomenclature;lift,dragandpitching momentcoefficients;centerofpressureandaerodynamiccenter. Potential flow Analysis; Scalar and vector fields, velocity potential, line,surfaceandvolumeintegrals,circulationandliftgeneration,Kutta-Joukovskii theorem. Methodofsuperposition,thinairfoiltheory,sourceandvortexmethods. **Subsonic Flow:**Subsonic compressible flow past airfoils; Critical Machnumber, drag divergence Mach number, supercritical airfoils, effect ofsweep,area rule.	20
II	Fullandperturbationvelocitypotentialformulations;PrandtlandGlauertc ompressibilitycorrections. Transonic flow past airfoils, transonic similarity rules; Supersonic flowpastairfoils, linearized supersonic flow. Potentialflowoverliftingwing,liftinglinetheory,vortexlatticemethod, slender body theory, variation of lift and drag coefficients insubsonic flows with angle of attack, Reynolds number, thickness-to-chordratio. Supersonic flow over airfoils and wings; subsonic/supersonic leadingedge Hypersonicflows,Newtoniantheory,liftanddraginhypersonicflows	20

Books/References:

- Anderson.JD,Jr.,FundamentalsofAerodynamics,McGrawHill2001.
- L.M.Milne/Thompson,TheoreticalAerodynamics.
- Houghton,E.L.andCarpenter,P.W.,AerodynamicsforEngineers,Butterworth-Heinemann,2001.

Online Education:

- MITOpenCourseware:MuddyPointAerodynamics.
- www.edx.org:AerodynamicsCourses:Problems&Assignments.
- https://www.grc.nasa.gov/www/k-12/airplane/presar.html

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

CO1 Aftercompletingthissubjectstudents willbeableto:
CO2.Definephysicalcharacteristicsofairandatmosphere.
CO3. Define basic aerodynamic forces acting on an aircraft and the factors affecting aerodynamic forces.CO4.Definegeometriccharacteristicsofairfoiland wing.
CO5.Explaintheeffects ofcamber,angleofattackandthicknessontheaerodynamiccharacteristicsofanairfoil.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	*POs/ PSOs*
CO1	*PO1,PO3,PO5/ PSO1,PSO3*
CO2	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO3	*PO1,PO2,PO3,PO4/ PSO1,PSO2,PSO3*
CO4	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO5	*PO1,PO3,PO5/ PSO1,PSO2,PSO3*

BMEE0104: TURBULENT FLOW

Pre-requisite:*AdvancedFluidMechanics*

Objective:*Toprovideageneralintroductiontothephysicsandmathematicaldescriptionofturbulence;Toi ntroducethemethodsofanalysisusedinturbulencestudy,Tounderstandtheprinciplesofturbulencesimulati onandmodeling.*

Credits:4 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction**:Propertiesoflaminarflow,Propertiesofturbulent flow, Boundary Layer, Growth rate of Boundary layerfor LaminarandTurbulentFlows. **Characteristics of Turbulent Flow**: The Origin of Turbulence,NatureofTurbulence,SwirlingStructure,MeanMotion andFluctuations,ConsequencesofTurbulence,Homogeneous-IsotropicTurbulence. **CorrelationFunctions&KolmogorovHypothesis**:CorrelationFunctions,Ideasabouteddysize,IntensityofTurbulenceorDegreeof Turbulence,KolmogorovUniversalLawfortheFineStructure,EnergyCascade,KolmogorovLengthScale,Kolmogorov'sFirstHypothesis,Kolmogorov'sSecondHypothesis. **Reynolds'AveragedNavier-StokesEquations:**FurtheronLawsofAveraging,Reynolds'Decomposition,ExamplesofTurbulentFluctuations,andSomeMeasurementsonFluctuatingComponents. **Measurements on Fluctuating Components**: Shear Stress duetotheFluctuations,TheboundarylayermeasurementsofKlebanoff.	19
II	**Turbulent Boundary Layer Equations**: Turbulent BoundaryLayer Equationsforatwodimensionalflow. **ClassicalIdealizationofTurbulentStresses**:Introduction,TheBoussinesqor eddyviscositymodel,Eddyviscosity. **Vorticity Dynamics**: Introduction, Vorticity and the equationsof motion, Reynolds stress and vorticity, Vortex Stretching. TheVorticityEquation,VorticityinTurbulent Flows. **Dynamics of Turbulence**: Kinetic Energy of the Mean Flow,KineticEnergyofFluctuations,SomeScaling Relations. **The Law of the Wall for Wall Bounded Flows**: The Law of theWallforWallBoundedFlows,TheUniversalVelocityProfile, FreeShearFlows,TurbulentJets,UniformEddyViscositymodel.	21

TextBooks:

RJ.Garde,*"TurbulentFlow"*NewAge International PvtLtdPublishers

ReferenceBooks:

- StephenB.Pope,"*TurbulentFlows*",CambridgeUniversityPress
- H.TennekesandJ.L.Lumley,*"AFirstCourseinTurbulence"*,MITPress

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*At theendof thiscoursestudentswill beableto*

CO1.Understandthecharacteristicsofturbulentflow. ***(Understand)***

*CO2.ExplaintheCorrelationFunctions&KolmogorovHypothesis.****(Understand)***

*CO3.UnderstandReynolds'AveragedNavier-StokesEquationsandTurbulentboundarylayerequation.****(Understand)***

*CO4. Understand measurementoffluctuatingcomponentsandturbulentstresses.****(Understand)***

*CO5.Understand VorticityandTurbulencedynamics.****(Understand)***

*CO6.Understandtheconceptofwallbounded flows.****(Understand)***

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	PSO/PO
CO1	PSO1/PO1/PO2
CO2	PSO1/PO1/PO2/PO3
CO3	PSO1/PO1/PO2/PO3
CO4	PSO1/PO1/PO2/PO3
CO5	PSO1/PO1/PO2
CO6	PSO1/PO1

BMEE0105:COMPUTATIONALFLUIDDYNAMICS

Objective: *TheobjectiveofCFDistomodelthe continuousfluidswithPartialDifferentialEquations(PDEs)anddiscretizePDEsintoanalgebraproblem(Taylorseries),solveit,validateitand achievesimulationbaseddesign.*

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** What is CFD, How Does A CFD Code Work, Applications of CFDandProblemSolvingWithCFD. Classification of Physical Behavior, The Role of Characteristics in HyperbolicEquations,ClassificationMethodforSimplePartialDifferentialEquation,Classification of Fluid Flow Equations, Auxiliary Conditions for Viscous FluidFlowEquation. **ConservationLawsofFluidMotionandBoundaryConditions:**Stresstensoroveracontrolvolume,EiensteinIndecies,KronwerDeltaConcept,GoverningEquationsofFluidFlow,EquationofState,Continuityequation in Cartesian coordinate, polar coordinate and spherical coordinatesystem,Navier – Stokes Equations for A Newtonian Fluid, Conservative Formof the Governing Equations for Fluid Flow, Differential and Integral Forms ofthe GeneralTransport Equation,Applicationsof NavierStokesequation ofmotion-Flowthroughpipe, flowbetweentwoparallelplatesetc. **TurbulentFlow:**Turbulence,typesofturbulence,continuityequationforturbulentflow.Navierstokesequationforturbulentflow.Reynoldsstresstensorfor turbulentflow **Turbulence and Its Modeling** Turbulence Models Such as Boussinesquemodel, Mixing Length Model, application of mixing length model, Von-Karmanturbulencemodel,applicationofVon-Karmanturbulencemodel,TheK–ƐModel,ReynoldsStressEquationModels.	20
II	**Potential Flow:** Source flow, Sink flow, Doublet, flow past a half body,flowovercylinder, pressure distribution. **The Finite Volume Method for Diffusion Problem:** Introduction, FiniteVolumeMethodforSteadyStateDiffusion,WorkedExamples:OneDimensionalSteadyStateDiffusion, **TheFiniteVolumeMethodforConvection–DiffusionProblem:**Introduction, Steady One Dimensional Convection and Diffusion, The CentralDifferencingScheme,PropertiesofDiscretisationScheme,TheUpwindDifferencingScheme,TheHybridDifferencingScheme,Propertiesof discretisationscheme.	20

Text Books:

- AndersonJ.,"*ComputationalFluidDynamicsAnIntroduction*",IIIEdition,Springer,2009.

Reference Books:

- ZikonavOleg,"*EssentialComputationalFluidDynamics*",JohnWiley&Sons,2010.
- BlazekJ.,"*ComputationalFluidDynamics:PrinciplesandApplications*",IIEdition,2009,ElsevierLtd.

Outcome:*Studentsareexpectedtolearn:*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcomes: Oncompletionofthis course,thestudentswillbeableto
CO1. Understand the Mathematical application used in CFD tools and techniques for effective designs ofstructuredgrid.

CO2. Apply modeling techniques to all the fluid dynamics, solid dynamics problems with respect to Multi-Disciplinary Industry.
CO3. Classify various computational methods for grid generation and its importance of efficient grid.CO4.Formulateunstructuredgridusingvariousmethodsbyconsideringdifferentboundaryconditions CO5.SimulatesimpleCFDmodelsand analyzeitsresults.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	*POs/PSOs*
CO1	*PO1,PO3,PO5/ PSO1,PSO3*
CO2	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO3	*PO1,PO2,PO3,PO4/ PSO1,PSO2,PSO3*
CO4	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO5	*PO1,PO3,PO5/ PSO1,PSO2,PSO3*

BMEE0184:MACHINEDRAWINGLAB

Objective: Students have an ability to apply knowledge of Modeling, science & engineering. Student can modelthis drawing even in CAD/CAM software by applying the basic knowledge of machine drawing. Students will ableto demonstrate an ability to design and conduct experiments, analyze and interpret data and assembly anddisassemblydrawingsknowledgewillbeprovided.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**OrthographicProjections**(1drawingsheet) Principleoffirstangleandthirdangleprojection,drawingofmachineelementsinfirst angleprojection, selectionof views, sectionalviews. **Screwedfasteners**(2drawingsheet) Threadnomenclature,Formsofthread,Threadseries,designation,Representation ofthreads,Boltedjoints,Lockingarrangementsofnuts,Foundationbolts. **Keys, Cotter Joint and Pin joint** (1 drawing sheet)Typesof keys,CotterjointorKnucklejoint. **Shaft Couplings** (1 drawing sheet)Rigid Coupling or Flexible coupling.**Rivetedjoints**(1drawings heet) Typesofrivetheads,Typesofrivetedjoints,Boilerjoint. **AssemblyDrawing** (1drawingsheet) Engine parts-stuffing box, cross head, Assembly drawing of eccentric, lathe tailstock,airvalve, screwjack, connecting rodsafetyvalveetc. **Freehandsketching** (sketchsheet) Free handsketchingoffoundation bolts,studs,pulleys,couplings,helical gear,bevelgear, crank,connecting rod, beltpulley, pistonetc. **ProductionDrawing** (2drawingsheets) Types,Examplesofsimplemachineelementslikehelicalgear,bevelgear,crank,con necting rod, beltpulley, pistonetc. **ComputerAidedDrafting**(2drawings) Introduction, input, output devices, introduction to software like AutoCAD,Pro-E, basic commands and development of 2D and 3D drawings of simpleparts.	24

Text Books:

- DhawanR.K,‘AText BookOfMachineDrawing’: SChand & CompanyPvt.Ltd.NewDelhi,2018.
- Agrawal&Agrawal,C.,‘EngineeringDrawing’ :TataMcGrawHill,2017.

Reference Books:

- JohnK.C.,‘AText BookOfMachineDrawing’:PHILearningPrivateLtd.NewDelhi,2010.
- DhawanR.K,‘ATextBookOfMachineDrawing’:SChand & CompanyPvt.Ltd.New Delhi,2018.
- JunnarkarN.D ‘MachineDrawing’:Pearson India,2006.
- Agrawal&Agrawal,C.,‘EngineeringDrawing’ :TataMcGrawHill,2017.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:*Afterstudyingthissubjectstudents willbeableto:*

- *CO1:AnalysiscomplexdesignsystemsrelatedtoMechanicalEngineering.*
- *CO1:Drawtheassemblyfromtheindividualpartdrawing.*
- *CO3:Improvetheirunderstandingofmachinedrawing,whichincludesclearvisualizationofobjects.*
- *CO4:Enhancetheirproficiencyinreadingandinterpretingawidevarietyofproductionandassembly drawings.*
- *CO5: Improve their understanding of drawings of assembled views for the part drawingsusingconventions andeasy drawing proportions.*

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/ PSO1
CO2	PO1,PO3/PSO1
CO3	PO3/ PSO1
CO4	PO3,PO10/PSO1
CO5	PO3,PO10/PSO1

BMEE0201COMPUTERAIDEDDESIGN

Pre-requisite:*MachineDesignII*

Objective:

- *TounderstandtheuseofInformationtechnologyintheDesignProcess.*
- *Tounderstandtheautomationofdesignprocess.*
- *TounderstandtheintegrationofCAD/CAMsystem.*
- *Tounderstandtheconceptofnumericaltechniqueinautomationofdesign.*

Credits:03 **L–T–P:3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:**IntroductiontoDesign,Elements/RequirementsofCAD,IntroductiontoCAEandCIMS,Necessity&ItsImportance,EngineeringApplicationsof CAD **ComputerGraphics-I** CADSystems,GraphicsInputDevices,OutputDevices,GraphicsDisplay Devices-CRT, LCD, LED, Touch panel display, Plasma Display,Virtual Display. Graphicsdisplay technique:- Random & Raster ScanDisplayGraphicsStandards,Animationandmultimedia,GraphicsFunctions,RasterizationofOutputPrimitives:LineDrawingAlgorithm,CircleGeneratingAlgorithm, **ComputerGraphics–II:-** Coordinate Representation, Windowing and Clipping, Object modeling.Geometric Transformations (2D/3D) - Translation, Scaling, Shearing,Rotation&ReflectionMatrixRepresentationandconcatenation. Candidatemustbesubmitonemini-projectbasedonComputergraphics-I andII. **Geometricmodelingofcurve:** PropertiesofCurveDesignandRepresentation,InterpolationVsApproximation.Parametricandnon-parametricrepresentationofCurves. Importance of Convex Hull. Parametric Continuity Conditions.Geometricmodelingofcurve:-HermiteCubicsplines,BezierCurves,BezierCurves.IntroductiontoNubCurve.IntroductiontoSurfacerepresentation.	20

II	**SolidModelling:-** Surfacefitting:Beziersurfacepatchmodel,B-splinesurfacepatchmodel,QuadricandSuper-quadricSurfaces. SolidModellingapproaches:- PolygonMeshRepresentations,BoundaryRepresentation,ConstructiveSolidGeometry,BlobbyObjects,Sweeping, Loftingandothermodelingmethods **Animationsystem:-** Animationsystem,animationtechnique,Softwareusedtoperformanimation. **Application of Numerical method in Automation of design:**Application,algorithmandprogramoffollowingnumericaltechnique:Rootfindingmethod:-N-Rmethods,Bi-sectionmethod. Interpolation:Newtonforwardandbackwardinterpolation,Lagrangeinterpolation.NumericaldifferentiationusingNewtonforwardand backwardformula.NumericalIntegration.	20
	IntroductiontoFiniteelementanalysis: IntroductionClassificationofDifferentialEquations,VariationalFormulationApproach,RitzMethod,GeneralizedDefinitionofAnElement, Element Equations From Variations, Introduction, Principlesof Finite Elements Modeling,Stiffness Matrix/Displacement Matrix.Stiffness Matrix for Spring System, Bar & Beam Elements,Bar Elementsin2DSpace (TrussElement) **ApplicationSoftware**:ApplicationCommandsforDraftingsoftware	

Text Books:

- *I.Zeid,"CAD/CAM:TheoryandPractices":TataMcGraw-Hill.*
- *R.KSrivastava,"ComputerAidedDesign":UmeshPublication.*

Reference Books:

- *P.NRao,"CAD/CAM:Principlesandapplications":TataMcGraw-Hill.*
- *R.BPatil:"Computeraideddesign":Tech-MaxPublication.*
- *J.NReddy,"Introductiontofiniteelementmethods":TataMcGraw-Hill.*
- *B.s.Grewal,"NumericalMethod":KhannaPublishers,2010.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofthecourse,studentwillbeableto:

CO1: Understand that the computer is not only a tool of visualization but also a tool forautomationofdesign.

CO2:Collaboratewithpeopleofdiversebackgroundsandabilities.

CO3:Identifythefactorsinthecomputeraidedprocessandproductdevelopment.CO4: Create the different wireframe primitives using parametric representations.CO5:Knowcomputeraideddesignconceptisnotlimitedto computerprograms.

CO6:Evaluatecomputeraideddesignmodelsandassembliesbasedoncriticalthinkingandp roblemsolving skills.

CO7:Communicateandpresentideasandsolutionstodesign problems.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	**PO1,PO3,PO6,PO10/PSO3**
CO2	**PO1,PO12/ PSO3**
CO3	**PO2,PO4,PO11/,PSO3**
CO4	**PO5,PO6,PO9,PO11/PSO3**
CO5	**PO3,PO4,PO10,PO12/PSO3**
CO6	**PO3,PO5,PO7,PO8,PO12/PSO3**
CO7	**PO8,PO9,PO11,PO12/PSO3**

BMEE0176ADVANCEDSOFTWARELAB

Objective: Toidentifytheroleofthesoftwareintoday’sDesignworld.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	• UseofPro/EngineerandPro/MechanicalSoftwareforExercisesin:DesignandAnalysisofMechanicalComponentDesignStudiedinSubjectsof MD-IandMD-II. • OptimizationofMechanicalDesignofComponentsandAssemblies. • ReverseEngineering ToolsandTheirUseinComponentDesign. • DesignAutomationandUserDefinedFeatures,AdvancedAssembly. • Structural,Welding,Surfacing,BehaviorModelerandOtherAdvancedModulesUseandDemonstrationof CaseStudies. • ApplicationofFiniteElementMethodstoElasticityProblemsandHeat TransferProblems.UsingANSYS, HYPERMESH,andFEMSoftware’s.	

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

COURSEOUTCOME: *AttheEndofthecourse,astudentwillableto:*

CO1.*UnderstandtheconceptAutoCAD,Pro/EngineerandANSYS.(Understand)*

CO2.*DesignanddrafttheanyworkshoputilitytoolwithapplicationofAUTOCAD/ProE.(Design)*

CO3.*UnderstandtheconceptofdraftingofthetwodailyutilityobjectslikechairandpodiumusingProE/AUTOCAD.(Understand)*

CO4.*DesigntheFlywheelAssemblyusingProE/AUTOCAD.(Design)*

CO5.*UnderstandthefailureconditionofARCweldingjoint.(Understand)*

CO6.*UnderstandtheconceptofanalysisofShaftunderloadusing ANSYS.(Understand)*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO3,PO9/PSO1,PSO3

CO2	PO3,PO5,PO9,PO10/PSO1, PSO3
CO3	PO2,PO3,PO9/PSO1,PSO3
CO4	PO3,PO5,PO9,PO10,PO12/ PSO1,PSO3
CO5	PO2,PO3,PO4,PO6,PO9/PSO1,PSO3
CO6	PO2,PO3,PO9/PSO1,PSO3

BMEE0202CONTINUUMMECHANICS

Pre-requisite:*StrengthofMaterials*

Objective:*The aim of the continuum mechanics is to deals with the analysis of the kinematicsand the mechanicalbehaviorof materialsmodeled asacontinuous mass rather thanasdiscrete particles.*

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	Cartesiantensors.Thelinearelasticboundaryvalueproblem.Boundaryconditions.Naviersequations.Planewaves.Generalconservation laws for mass, momentum and angular momentum.**Deformationofacontinuum:**EulerandLagrangedescriptions,displacement vector, strain tensor, principal strains, compatibilityequations.	20
II	**The state of stress in a continuum:** stress vector, stress tensor,principalstress, equations ofmotion. **Constitutive equations:** isotropic and anisotropic linear elasticmaterials.Newtonianfluids:compressibleandincompressible fluids,Navier-Stokes equations.	20

TextBooks:

- P.Chadwick,“ContinuumMechanics:ConciseTheoryandProblems”: Dover Publications,2012.
- J.W.Rudnicki, “Fundamentalsof ContinuumMechanics”:WileyPublications,2014.

ReferenceBooks:

- Y.C.fung,“AFirst CourseinContinuumMechanics”: Pearsonpublication,1993.
- W. M. Lai and D. H. Rubin, “Introduction to Continuum Mechanics”: Butterworth-HeinemannPublication,2009.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:*Attheendofthecoursethestudentwillbeableto:*

- **CO1:**Applythetensorformalism,
- **CO2:**Analyzegeneralstressesanddeformationsincontinuousmaterials.
- **CO3:** Formulateandsolvespecifictechnical problemsofdisplacement,strainandstress.
- **CO4:** Numerically model and analyze the stresses and deformations of simple geometries under anarbitraryload inboth solidsand liquids.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO3
CO2	PO2,PO3/PSO3
CO3	PO1,PO3/PSO3
CO4	PO1,PO3,PO4/PSO3

BMEE0203FINITEELEMENT METHODS

Pre-requisite:*ContinuumMechanics*

Course objective: *The objective of this course is to teach in a unified manner the fundamentalsofthefiniteelementmethodfortheanalysisofengineeringproblemsarisinginsolids*

,structuresandsomebasicthermalengineering.Thecoursewillemphasizethesolutionofreal life problems using the finite element method underscoring the importance of the choiceof the proper mathematical model, discretization techniques and element selection criteria.Finally, students will learn how to judge the quality of the numerical solution and improveaccuracyinan efficientmanner byoptimalselectionofsolution variables.

Credits:04 **L–T–P:3-1-0**

Module No.	Contents	Teaching Hours
1	**Introduction:** Finiteelementmethodasanumericaltoolfordesign,Basicconcepts,Formulationprocedures,Historical development. **LineElementsandApplications:** Structural Problems: Linear and Quadratic elements, 1D Bar element,FormulationofTrusselement,Planetruss,Euler–Bernoullibeamelementformulation. ThermalandFluidProblems:Steadystateheattransfer:Elementformulations, treatment to boundary conditions with application to 1-Dheatconduction,heattransferthroughthinfins;Potentialflowproblems **2D Elements**: Triangular (CST, LST): Shape function, Jacobian matrix,strain-displacementmatrix,stress-strainrelationshipmatrix,forcevector. QuadrilateralElements(Q4,Q8):Shapefunction,Jacobianmatrix, strain-displacementmatrix,stress-strainrelationshipmatrix,forcevector.	20
2	**Application to Field Problems**: Thermal problems, Torsion of Noncircular shafts, Plane stress, plane strain and axisymmetric problems –Bodyforcesandtemperatureeffects,Stresscalculations,Plateandshellelements **DynamicProblems:**Formulationofdynamicproblems,consistentandlumped massmatrices for1-D and2-Delement, Solutionofeigenvalue1-Dproblems-Longitudinalandtransversevibrationofbeamswithallpossibleboundary conditions:Transformationmethods,Jacobimethod,VectorIterationmethods, subspaceiterationmethod.Solutionto1DtransientHeattransferproblems.	20

TextBooks

- T. R. Chandrupatla, Finite Element Analysis for Engineering and Technology, UniversityPress,2018
- P.Seshu,TextBookofFiniteElementAnalysis,PHILearningPvt.Ltd.,2012
- J. N. Reddy, An Introduction to the Finite Element Method, McGraw Hill InternationalEdition,2005

ReferenceBooks

- S.S.Rao,TheFiniteElementMethodinEngineering,ButterworthHeinemann,2017
- K.J.Bathe,FiniteElementProceduresinEngineeringAnalysis,PrenticeHallofIndia,2007
- O.C.Zienkiewics,R.L.Taylor,TheFiniteElementMethod,VolI&II,McGrawHill,1967

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome:

- *CO1:Understandthebasictheoryoffinite-elementmethod.*
- CO2:*Tounderstandtheuseofthebasicfiniteelementsforstructuralapplicationsusingtruss,beam,frame,and...*
- CO3:*Understandtheroleandsignificanceofshapefunctionsinfiniteelementformulationsanduselinear,quad ratic, andcubicshapefunctionsfor interpolation.*
- CO4:*Understandtheformulationofone-dimensional,twodimensionalandthreedimensionalelements.*
- CO5:*RecognizesourcesoferrorsinFEA.*
- CO6:*todeveloptheabilitytogeneratethegoverningFEequationsforsystemsgovernedbypartialdifferential equations*

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO1,PO2/PSO1
CO4	PO1/PSO1
CO5	PO5/PSO1
CO6	PO2,PO3/PSO1

BMEE0204VIBRATION&NOISE

Pre-requisite:*DynamicsofMachine*

Course objective:*The objective of this course is to have a clear understanding of vibrationsandmodellingofmechanicalsystems.Studentswillanalysefreeandforcedvibrationsand willdevelop mathematicaltechniquestomodelanddesignmechanical systems.*

Credits:04 **L–T–P:3-1-0**

Module No.	Contents	Teaching Hours
I	**Introduction:**FreeandForcedVibrationsofSingleDegreeofFreedomSystem, Newton's Second Law, D'Alembert's Principle, Lagrange'sEquation, Types of Damping, Algorithmic Decrement, Equivalent ViscousDamping,Support Excitation. **Basic Vibration Control:** reduction at source, Active feedback control,VibrationIsolationandTransmissibility. Two Degree of Freedom Systems: Free and Forced Vibrations With andWithoutDamping,PrincipleandNormalModes,VibrationAbsorbers. **Multi Degree of Freedom Systems:** Various Methods of Analysis of MultiDegreeFreedomSystems,InfluenceCoefficients,CouplingofModes,Rayleigh'sMethod, Dunkerley's Equation,Holzer'sMethod	22
II	**VibrationofContinuousSystems:**WaveEquation,LongitudinalVibrationof Bars, LateralVibrationsof Beam. **PassiveVibrationControl:**Basics,designofabsorber,absorberwithidealspring,shockabsorber,isolators withstiffnessanddamping. **ActiveVibrationControl:**Basics,Piezoelectricmaterials,electrorheologicalfluids,magnetorheologicalfluids,Magneto-andElectrostrictiveMaterialsinVibrationControl. **VibrationMeasurement:**Basics,dataacquisition,IntroductiontoCondition Monitoringof Machinery,FFT analysisandfilters	20

TextBooks

- G.K.Grover,"MechanicalVibrations": NemChandandBros,2009.
- S.S.Rao,"MechanicalVibrations",AddisonWesleyPublishingCompany,1990.
- S.G.Kelly,"MechanicalVibrations,Schaum'sOutlines",TataMcGrawHill, 2008.

ReferenceBooks

- J.S.rao,"VibrationConditionMonitoringofMachines":TataMc-GrawHill,2006.
- D.J.Inman,"VibrationandControl":JohnWilley&SonsInc,2002.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Afterstudyingthissubjectstudentswillbeableto:*

- **CO1:**Analyzethemathematicalmodelingofthetwodegreesoffreedomsystemsandexplainabout the workingprincipleof vibration absorber.
- **CO2:**Computethenaturalfrequenciesandmodeshapesofamultidegreeoffreedomsystemandex plainthe modalanalysisof a vibratingsystem.
- **CO3:**AbilitytouseLagrange'sequationsforlinearandnonlinearvibratorysystems.
- **CO4:**Understoodtheparametersandvariablesofavibratingsystem.
- **CO5:**Understoodtheconceptofnaturalfrequencyandhowtofinditforavibratingsystem.
- **CO6:**Learntheprocessofvibrationmeasurementsandcontrol.

MappingofCourseOutcomes(COs)withProgram outcomes(POs)andProgram SpecificOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO3
CO2	PO1,PO2/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO2/PSO3
CO5	PO1,PO3/PSO3
CO6	PO1/PSO3

BMEE0301COMPUTERAIDEDMANUFACTURING

Pre-requisite:*ManufacturingScienceII*

Objective:*AcquirefundamentalunderstandingoftheprinciplesofCAM,includingCNCprogramming,conceptofCIM &Robotics.*

Credits:03 **L–T–P:3–0–0**

Modu leNo.	Contents	Teaching Hours
I	**Automation:** IntroductiontoCAM;AutomatedManufacturingSystem;Automation,NeedofAutomation,BasicElementsofAutomation,LevelsofAutomation,AutomationStrategies,Advantages&DisadvantagesofAutomation,HistoricalDevelopmentandFutureTrends. **NCSystem:** Fundamental of Numerical Control, Elements of NC Machine Tools, Classification ofNC MachineTools, Advantages, Suitability andLimitations of NC MachineTools,ApplicationofNCSystem,MethodsforImprovingAccuracyConsideringtheFactorsSuchasToolDeflectionandChatterandProductivity.ToolingofNCMachines.ConfigurationofCNC,DNCandAdaptiveControl. **NCPartProgramming** (A) Manual (Word Address Format) Programming. Examples Drilling, Turning andMilling;CannedCycles,Subroutine,andMacro. (B) APTProgramming.Geometry,MotionandAdditionalStatements,Macro-Statement.	20
II	**SystemDevices:** Feed Back Devices, Counting Devices, Digital to Analog Converter and Vice Versa.Interpolatorslike Digital Differential IntegratorLinear, CircularComputerAidedInspection(CAI)andComputerAidedTesting(CAT). **ComputerIntegratedManufacturingSystem** Concept of ComputerIntegratedManufacturingSystem, Impact of CIM on personnel,Role ofmanufacturingengineers, CIMWheel tounderstand basicfunctions. GroupTechnology,FlexibleManufacturingSystem,CAD/CAM,ComputerAidedProcessPlanning-Retrieval andGenerative,ConceptofMechatronics. **Robotics** Robot Anatomy, Laws of Robot, Human System and Robotics, Coordinate system,SpecificationsofRobot.Powersources,actuatorsandTransducers,RoboticSensors,Grippers,RobotSafety,RobotProgrammingandRobotApplications.	20

TextBooks:

- KundraandRao,"*ComputerAidedManufacturing*",TMH,NewDelhi.
- Koren,"*ComputercontrolofManufacturingsystems*",TMH,NewDelhi.
- Koren,"*NCMachines*",TMH,NewDelhi.

ReferenceBooks:

- Groover Mikell P., "*Automation, Production Systems and Computer IntegratedManufacturing*",PrenticeHallPublishers.
- S.J.Martin,"*NCMachineTools*",TMH,NewDelhi.
- Groover,"*CAD/CAM*",PrenticeHallPublishers.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

CourseOutcome*:Aftercompletionofthiscourse,theStudentswillbeableto:*

- CO1:Understandtheneedofautomationanditsstrategiesusedfordevelopmentinmanufacturing.(Understand)
- *CO2:DescribebasicconceptsofCAMapplicationandCIMwheel.(Remember)*
- *CO3:PrepareCNCprogramsformanufacturingofdifferentgeometriesonmillingandlathemachines.(Apply)*
- CO4:Understandtheconceptofgrouptechnology,CIM,FMSandCAPPsystemusedinindustries.(Remember)
- CO5:DescribetheuseoffeedbackdevicesusedinCNCmachines.(Remember)
- CO6:IllustratethebasicpartsandnecessityofRoboticsysteminIndustries.(Understand)

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	PO/PSO
CO1	PO3/PSO2
CO2	PO1,PO3/PSO2
CO3	PO1,PO6/PSO2
CO4	PO2/PSO2
CO5	PO1/PSO2
CO6	PO6/PSO2

BMEE0178CAD/CAMLAB

Objective: ToStudyandacquireknowledgeonvariouscomputerbaseddesigningandmachiningo perationsinspecialpurpose machinesanditsapplications inreallife manufacture ofcomponentsintheindustry.

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
	TotalTENExperimentsaretoCarryOut.FIVEExperimentsEachFromCAD and CAM. **A. CADExperiments** • LineDrawingorCircleDrawingExperiment:WritingandValidationofComputerProgram. • GeometricTransformationAlgorithmExperimentforTranslation/Rotation/Scaling: WritingandValidationofComputerProgram. • DesignofMachineComponentorOtherSystemExperiment:WritingandValidationof Computer Program. • UnderstandingandUseofAny3-DModelingSoftwareCommands. • Pro/E/IdeaEtc.Experiment:SolidModelingofAMachineComponent • Writing A Small Program for FEM for 2 Spring System and Validation ofProgramorUsingAFemPackage. • RootFindingsorCurveFittingExperiment:WritingandValidationofComputerProgram. • NumericalDifferentiationorNumericalIntegrationExperiment:Writing andValidationof ComputerProgram. **B. CAMExperiments** • ToStudytheCharacteristicFeaturesofCNCMachine. • Part Programming (in Word Address Format) Experiment for Turning.Operation (Including Operations Such as Grooving and Threading) andRunningonCNCMachine. • PartProgramming(inWordAddressFormatorATP)ExperimentforDrillingOperation(PointtoPoint) andRunningonCNC Machine. • PartProgramming(in Word Address Formator ATP)ExperimentforMillingOperation(Contouring)and Running onCNCMachine. • ExperimentonRobotandPrograms. • ExperimentonTransferLine/MaterialHandling. • ExperimentonDifferencebetweenOrdinaryandNCMachine,StudyorRetrofitting. • ExperimentonStudyofSystemDevicesSuchasMotorsandFeedBackDevices. • ExperimentonMecatronicsandControls.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Uponsuccessfulcompletionstudentsshouldbeableto:

- *CO1:Useanunderstandingof GeneralandMachine(G&M)codetogenerateoreditaprogram.(Apply)*
- *CO2:Understandtheuseof3-Dmodelsoftwarecommands.(Apply)*
- *CO3:OperateCNClathe&CNCMillingmachines.(Apply)*
- *CO4:UseAdditivemanufacturingequipment3Dscannerandprinter.(Apply)*

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO3/PSO2
CO3	PO1/PSO2
CO4	PO5/PSO2

BMEE0192PROJECTBASEDCAD/CAMLAB

Credits:02 **L–T–P-J:0–0–0-8**

Objectives

- To impart fundamental knowledge to students in the latest technologicaltopics on Computer Aided Design, Computer Aided Manufacturing andComputer Aided Engineering Analysis and to prepare them for taking upfurtherresearchinthe areas.
- Tocreatecongenialenvironmentthatpromoteslearning,growthandimpartsability toworkwithinterdisciplinarygroupsinprofessional,industryandresearchorganiz ations.
- To broaden and deepen their capabilities in analytical and experimentalresearch methods, analysis of data, and drawing relevant conclusions forscholarlywritingand presentation.
- Toprovideguidancetostudentsfortheirchoicesinresearchandprofessionalcareer outlookandtoencouragestudentstotakeupresearch.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcomes

Aftercompletionofthiscourse,studentswillbeableto

- CO1:Apply/developsolutionsortodoresearchintheareasofDesignandsimulatio ninMechanicalEngineering.(Apply)
- CO2:Model&Analyzemechanicalcomponentusing3-Dmodelsoftwarecommands.(Apply)
- CO3:ProgrammingonCNClathe&CNCMillingmachines.(Apply)
- CO4:IllustrateUseofAdditivemanufacturing.(Apply)

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO11/PSO2
CO2	PO3/PSO2
CO3	PO1/PSO2
CO4	PO4/PSO2

BMEE0302WELDINGSCIENCEANDTECHNOLOGY

Pre-requisite:*ManufacturingScienceI*

Objective:*Toimpartthecomprehensiveinsightintovariousbasicandadvanced Weldingprocessesandtheir applicationto differentmaterials.*

Credits:03 **L–T–P:3–0–0**

Module	Contents	Teaching Hours
1	**Introduction:** Welding as compared with other fabrication processes, Importanceandapplicationofwelding,classificationofweldingprocesses,Health&safetymeasuresinwelding.WeldingPowerSources:PhysicsofweldingArcBasiccharacteristicsofpowersourcesforvariousarcweldingprocesses,Physicsof**Welding Arc:** Welding arc, arc initiation,arc efficiency, heat generation at cathodeandanode, Effectof shielding gasonarc,isothermsof arcsandarcblow. **Metal Transfer:** Mechanism and types ofmetal transfer in various arc weldingprocesses. **Weldability:** Effects of alloying elements on weld ability, welding of plain carbonsteel,CastIronandaluminium. **Welding Processes:** Shielded Metal Arc Welding (SMAW),TIG, MIG, Plasma Arc,SubmergedArcWelding,ElectrogasandElectroslag,FluxCoredArcWelding,Resistancewelding,	23
2	**Welding Processes (Contd…):**Friction welding,, Friction Stir Welding, Ultrasonicwelding,Explosivewelding,Laserbeam,welding,Electronbeamwelding,Underwaterwelding, Brazing,Soldering andBrazeweldingprocesses. **Heat Flow Welding:** Calculation of peak temperature; Width of Heat Affected Zone(HAZ); cooling rate and solidification rates; weld thermal cycles;residual stressesandtheirmeasurement;welddistortionanditsprevention. **Repair&MaintenanceWelding:**Hardfacing,Cladding,Surfacing,Metallizingprocessesand Reclamationwelding. Micro&Macrostructuresinwelding. **Weld Design:** Types of welds & joints, Joint Design, Welding Symbols, weld defects,Inspection/testingofwelds,IntroductiontoWeldingProcedureSpecification&ProcedureQualificationRecord.	22

Text Books:

ParmarR.S.,“WeldingProcesses&Technology”,KhannapublishersNad
karni, S.V., “Modern Arc Welding Technology”, Oxford &
IBHCaryHobartB. ,“ModernWeldingTechnology”,PrenticeHall

Smit,Dave,“WeldingSkills”

Little R. “Welding technology”,Tata McGraw-
HillKearns, W.H.,“WeldingHandbook”Vol.3, AWS,Miami

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcomes:

Studentsareexpectedtolearn:

Oncompletionofthiscourse,thestudentswould beableto:

CO1.Thestudentwillbeabletounderstandthefundamentalprinciples ofweldingprocesses.

CO2.Thestudent willbeabletoascertainthekeyparameters ofeachprocess,

CO3.Thestudent willbeabletoPredict thematerialbehaviourupon welding,

CO4.ThestudentwillabletoDesignappropriatePreandpostweldingHeattreatments(PWHT).

CO5.ThestudentwillabletounderstandInspection/testingofwelds,ProcedureSpecification&ProcedureQualificationRecordetc.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs):

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO4 / PSO2
CO4	PO5 / PSO2
CO5	PO3 / PSO2

BMEE0185WELDINGSCIENCEANDTECHNOLOGYLAB

Pre-requisite:*ManufacturingScience -ILab*

Objective:*This course introduces thefundamentalslatest techniques and procedures forbeginning to advanced welding processes, The Course will provide hands on training weldingtheorytrainingtopics,weldjointsandpositions,weldingsafety,weldandbasemetalnomenclature, defects, inspection criteria, weld techniques and troubleshooting. Sample workwill undergo inspection as part of testing to ensure that they conform to American WeldingSociety(AWS).*

Credits:01 **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
1	**ListofExperiments:** **1.** Welding Groove preparation as per the American WeldingSociety(AWS)Code **2.** ButtandlapJointpreparationbyShieldedMetalArcWelding (SMAW)process. **3.** TopreparebuttandlapjointbyGasTungstenArcWelding (GTAW)process **4.** Toprepare buttandTjointbyGas WeldingProcess(Withvarying Flame). **5.** TopreparebuttjointbySubmergedArcWelding(SAW)process. **6.** HAZmicrostructuralanalysisusingopticalMicroscope **7.** ComparisonofHardnessinFusionZone(FZ),HeatAffectedZone(HAZ)andParentmetalofarcweldment. **8.** SheetMetalfabricationUsingResistanceSpotWelding **9.** ImpactstrengthanalysisofweldjointthroughCharpyand Izod Test. **10.** FrictionStir weldingofAluminium alloys	24

Outcome: Attheend ofthecoursethestudentwill beable

CO1. The student will be able to know the practical skills to weld in (flat,horizontal,verticalpositions,)usingthebasicweldingprocessesSMAW,GTAWetc.

CO2. The student will be able to know the basic fundamentals of weldingprocessesandapplicationsandmetallurgy.

CO3.The student will be able to know to develop basic know how andawarenessto dealwithpracticalaspectsofadvancedweldingandtheirmicrostructural analysis.

CO4.Thestudentwill beableto know aboutthemechanicalpropertiesand theirrequirementsforstructures.

CO5.Thestudentwillbeabletoknow differentadvancedjoiningoperations.

MappingofCourseOutcomes(Cos)with ProgramOutcomes(Pos)andProgramSpecificOutcomes(PSOs)

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO4 / PSO2
CO4	PO5 / PSO2
CO5	PO3 / PSO2

BMEE0303COMPOSITEMATERIALS

Pre-requisite:_MaterialScience_

Objective: _The objective for this course is to develop an understanding of the linear elastic analysis ofcomposite materials. This understanding will include concepts such as anisotropic material behaviorandtheanalysisoflaminatedplates.Thestudentswillundertakeadesignprojectinvolvingapplication of fiber reinforced laminates. Detailed study of biaxial strength theories of orthotropicmaterials are also of interest. Fundamentals of engineering constants, special cases of laminates areemphasized. The students are introduced to reinforced materials, their base materials, selection andapplications._

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Composite Materials:** Classification of various compositematerials. Reinforcements: Fibers: fabrication, properties and applications ofglass fibers, boron fibers, carbon fibers, organic fibers, Kevelar fibers, ceramicfibers, metallicfibers(metallicglasses). **Particulates:**PropertiesandapplicationofSiC,Al_2O_3,Si_3N_4andTiCparticulates. **Matrix Materials:**Functionsof a Matrix,DesiredPropertiesof aMatrix,PolymerMatrix(ThermosetsandThermoplastics),Metalmatrix,Ceramic matrix, CarbonMatrix,GlassMatrixetc. **MetalMatrixComposites:**Solidstate,liquidstateandin-situfabrication techniques of MMCs, Discontinuous reinforcement of MMCs, Properties andapplicationsof MMCs.	20
II	**CeramicMatrixComposites:**Fabrication,propertiesandinterfacesinCMCs. Toughness of CMCs, applications of CMCs. Carbon Fiber Composites:Fabrication, propertiesandinterfaces. **MechanicsofCompositeMaterials:**Density,mechanicalproperties,predication of elastic constants, transverse stresses, and thermal properties.Mechanicsofloadtransferfrommatrixtofibers,relationshipbetweenengineeringconstants,analysisoflaminatedcomposites. **Strength, Fracture and Design of Composites:** Tensile and compressivestrengthofcomposites,Fracturemodesincomposites,Strengthoforthotropic lamina, maximum stress theory, maximum strain criterion, maximum workcriterion.	20

TextBook:

- S.W.TsaiandH.T.Hahn, “IntroductiontoCompositeMaterials”:TechnomicPublishingCo.,1980.
- A.K.Kaw,“Mechanicsofcompositematerials”:CRCPress,1997.
- MukhopadhyayMadhujit,“MechanicsofCompositeMaterialsandStructures”:UniversityPress, 2005.

ReferenceBooks:

- RoberM.Joness,“MechanicsofCompositeMaterials”:Mc-GrawHillKogakushaLtd,1975.

- MichaelW.Hyer,“StressAnalysisofFiberReinforcedCompositeMaterials”:MGHInternational,2009.
- KrishanK.Chawla,“CompositeMaterialScienceandEngineering”:Springer,1987.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftersuccessfulcompletionofthiscourse,thestudentwillbeableto:

- CO1:Understandingofsmartmaterials,manufacturingprocesses,advantagesandapplications.
- CO2: Identify and Evaluate the properties of fiber reinforcements, particulates, matrix materialsandcommercialcomposites.
- CO3:Developcompetencyinoneormorecommoncompositemanufacturingtechniques andbeabletoselectappropriatetechniqueformanufactureofcompositeproducts.
- CO4: Analyze and understand the mechanical properties and mechanics of load transfer frommatrixtofibers.
- CO5: Understand and predict the mechanical performance and failure behaviour of thecomposites.
- CO6: Apply the knowledge of manufacturing methods and composite mechanical performanceofa given composites designproject.
- CO7:Tounderstandthedifferenttestingmethods/Characterizationofsmartmaterials.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO1/PO4/PO5/PSO1/PSO2/PSO3
CO3	PO1/PSO2
CO4	PO1/PSO1
CO5	PO1/PO4/PSO3
CO6	PO1/PO2/PSO2/PSO3
CO7	PO1/PSO2/PSO3

BMEE0304MODERNMANUFACTURINGPROCESS

Objective:*In this course students acquire the ability to know and understand the advance machines andtheir operations. Students will be able to formulate problems in advanced metal cutting and evaluate thecuttingparameters,establishacompletesolutiontometalcuttingproblemsusingmathematicalorgraphicaltechniques.*

Credits:03 **L–T–P: 3–0–0**

Module	Contents	Contact Hours
1	**Introduction:** Types of advanced manufacturing processes; Evolution, need,andclassificationof advancedmachiningprocesses(AMPs). **MechanicalTypeMMPs:**USM,AJM,WJM,AWJMprocesses:Processprincipleandelements;Tooldesign;Mechanismofmaterial removal,parametricanalysis;Shape andmaterialapplications;Operationalcharacteristics;Limitations. **AdvancedSuperFinishingProcess:**Abrasive Flow Machining;MagneticAbrasiveFinishing;MagnetoRheologicalAbrasiveFinishing:Processprinciple, process equipment; Analysis and modeling of finishing mechanism;Parametricanalysis;Applications. **Chemical Type AMPs:** Process principle and details of Chemical Machining;Photo-ChemicalMachining,andBio-ChemicalMachiningprocesses.	21
2	**Electro Chemical Type AMPs:** ECM-Process principle, mechanism of materialremoval;KinematicsanddynamicsofECM;Toolingdesign;Choiceandanalysisof processparameters;Surfacefinishandaccuracy **Thermal Type AMPs:** EDM, LBM, EBM, IBM, PAM processes: Workingprinciple; Power circuits; Mechanism of material removal; Process parametersandcharacteristics;Surfacefinishandaccuracy:Shapeandmaterialsapplications,limitations. **Derived and Hybrid AMPs:** Introduction of processes like rotary ultrasonicmachining, electro stream drilling, shaped tube electro machining, wire electrodischargemachining,electrochemicalgrinding,electrochemicalhoning,electrochemicaldeburringandelectro-chemicalsparkmachining. **Misc.Topics:**Process selectionandprocessplanningforAMPs.	21

TextBook:

1. Mishra,P.K.,“NonconventionalMachining”,NarosaPublishingHouse.
2. Pandey, P.C.,andShan, H.S.,“ModernMachiningProcesses”, TataMcGraw-Hill.
3. Jain,V.K.,“AdvancedMachiningProcesses”,AlliedPublishers.
4. Benedict,G.F.,“NontraditionalManufacturingProcesses”, MarcelDekker.
5. McGeough, J.A.,“AdvanceMethodofMachining”,ChapmanandHall.

6. Ghosh,A.,andMallik, A.K.,“ManufacturingScience”, AffiliatedEast-WestPress.

Outcomes:

Studentsareexpectedtolearn:

Oncompletionofthis course,thestudentswould beableto:

CO1.Thestudentwillbeabletoperformadvanceoperationsinmanufacturingprocesses.

CO2.Thestudentwillbeabletoapplyengineeringmathematicsto solvethebasicproblemsofmetalcutting.

CO3.Thestudentwillbeabletohavein-depthknowledgeofmachines,mechanismsandtheiroperationsformaterialremovalusingadvance machines.

CO4Thestudentwillbeabletoperformprocessselectionandplanningforadvancedmanufacturingprocesses.

CO5Thestudentwillbeabletounderstanddifferentoperationsofmanufacturingfordifferenttypesofmachinesandprocesses.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 /PSO2
CO3	PO3 /PSO2
CO4	PO5 /PSO2
CO5	PO4 / PSO2

BMEE0179MODERNMANUFACTURINGPROCESSLAB

Pre-requisite:*ManufacturingScience -ILab*

Objective:*Thiscourseintroducesthelatesttechniquesandproceduresforadvancedmanufacturing processes, The Course will provide hands on training of some manufacturingtheory training topics. Sample work will undergo inspection as part of testing to ensure thattheyconform tosetstandards.*

Credits:01 **L–T–P-J:0–0–2-0**

- TodeterminethemetalremovalrateofAJMprocessbycontrollingmachiningparameters.
- TodeterminetheMRRofUSMbycontrollingtheslurryflowratefrequencyandamplitude.
- TodeterminetheMRReffectofelectrolyteflowroleonMRRinECM.
- ToinvestigatethesurfaceroughnessofmachinedsurfacebyEDMundervariableparamet er.
- To determine themetalremovalratebyEDMundercontrolparameter.
- TodeterminetheMRRofLBMbyvariableparameter& itseffectonmetalstructure.
- Todesign&manufactureacomponentby3Dprinting.
- ToinvestigatethemachinedzonebywirecutEDM.
- Tofabricate&studyahybridmachining setup (miniproject)

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheend ofthecoursethestudentwill beable

CO1. The student will be able to know the practical skills to work with differentmanufacturingmachines.

CO2.Thestudentwillbeabletoknow thebasicfundamentalsofsomeadvancedimportantmanufacturingoperations.

CO3.The student will be able to know to develop basic know how andawareness to deal with practical aspects of advanced manufacturing operations.CO4.Thestudentwill beableto know aboutthemechanicalpropertiesand theirrequirementsforvariousstructures.

CO5. The student will be able to investigate different modern manufacturingoperations.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs /PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO4 / PSO2
CO4	PO3 / PSO2
CO5	PO5 / PSO2

BMEE0193PROJECTBASEDMODERNMANUFACTURINGPROCESSLAB

Pre-requisite:*ManufacturingScience –IandIILabs*

Objective:*This course introduces thefundamentalslatest techniques and procedures foradvancedadvancedmanufacturingprocesses,TheCoursewillprovidehandsontrainingdifferen t manufacturing processes. Sample work will undergo inspection as part of testing toensurethattheyconfirm todifferentstandards.*

Credits:02 **L–T–P-J:0–0–0-8**

1. Designandfabricationofmicroabrasivejet formachining brittlematerials.
2. Designandfabricationofselfcenteringtablevicefordrillingmachine.
3. Applicationofjust-in-timemanufacturestrategyinasmallscaleindustry.
4. Designandfabricationofdrilltooldynamometer.
5. Toeloadmeasuringdevice.
6. ApplicationofTaugchitechnique/designofexperimenttohelmentmanufacturingprocess.
7. Designandfabricationofgearcuttingattachmentforlathe.
8. Computeraidedfeatureextractionandcncpartprogramgenerationforrotationalparts.
9. Designandfabricationofmeltingpotforindirectarcfurnace.
10. Designandfabricationofprogressivedie.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Attheend ofthecoursethestudentwill beable

CO1.Thestudentwillbeabletoknow thepracticalskillstodesignandfabricatedifferentmanufacturingprocesses.

CO2.Thestudentwillbeabletoknowtoknowthebasicfundamentalsofdifferentmanufacturing processes.

CO3.The student will be able to know to develop basic know how andawareness to deal with practical aspects of advanced manufacturing processes.CO4. The student will be able to know about the programs developed to enhancetheworkingcapability.

CO5. The student will be able to know different advanced machining andmanufacturingoperations.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs / PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO3 / PSO2
CO4	PO3 / PSO2
CO5	PO4 / PSO2

BMEE0305METALFORMINGANALYSIS

Pre-requisite:*ManufacturingScienceI*

Objectives: *To make the students understand the mechanics of metal forming and their behavior undervariousmetalforming processes.*

Credits:03 **L–T–P:3–0–0**

ModuleNo.	**Contents**	**TeachingHours** (Approx.)
I	Reviewoftwodimensionalstressandstrain,stateofstressinthreedimensions,Stresstensor,Invariants,Mohr'scirclefor3-dimensionalstateofstress, strain at a point-Mohr's circle for strain, Hydrostatic & Deviatorycomponents of stress, Elastic stress strainrelations.Elements of theory ofplasticity; Flow curve, True stress & true strain, Yield criteria for ductilemetals, Von Misses & Teresa yield criteria, combined stress tests. The yieldlocus,Anisotropyinyielding,Yield surface, levy-Misses, Prandtl-Reuss Stress-Strain relation, Classification offormingprocessesvariablesinmetalformingandtheiroptimizationAnalysisof deformation processes- Method based on homogeneous compression sliplinefieldtheory,Upperboundsandlowerbounds,Slabmethodofanalysis.	22
II	Flow stress determination, Hot working, Cold working, Strain rate effect,Friction and lubrication, Deformation zone geometry, Workability, Residualstress. Analysis of metal forming processes (only limited portion), Forging: Loadcalculationinplanestrainforging,Rolling:Forces&geometricalrelationshipinrolling,Rollingloadandtorqueincoldrolling,Von-Karmanworkequation,Extrusion: Analysisof extrusionprocess,extrusionpressure,Drawing: Drawingload	20

TextBooks:

- R.HWagoner,Metal FormingAnalysis,CambridgeUniversityPress
- G.W.Rowe,PrinciplesofIndustrial Metal workingprocesses,CBS publishersandDistributors
- B. L.Juneja,FundamentalsofMetal formingprocesses,Newageinternationalpublishers
- GhoshandA.K.Malik, ManufacturingScience, EastWestPress

ReferenceBooks:

- Johson&Mellor,VanNostrand: EngineeringPlasticity.
- Avitzur,McGrawHill:Metalworking.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:

Afterlearningthecoursethestudentsshouldbeableto:CO1
.Identifyvariousformingprocess;

CO2.
Identifyanddeterminevariousyieldcriteriausedinformingprocess;CO3.Lear
n mechanicsofforgingprocesses;

CO4. Learn mechanics of extraction
processes;CO5.Learn mechanicsof
drawingprocesses.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs / PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO1 / PSO2
CO4	PO2 / PSO2
CO5	PO1 / PSO2

BMEE0305METALFORMINGANALYSIS

Pre-requisite:*ManufacturingScienceI*

Objectives: *To make the students understand the mechanics of metal forming and their behavior undervariousmetalforming processes.*

Credits:03 **L–T–P:3–0–0**

ModuleNo.	**Contents**	**TeachingHours** (Approx.)
I	Reviewoftwodimensionalstressandstrain,stateofstressinthreedimensions,Stresstensor,Invariants,Mohr'scirclefor3-dimensionalstateofstress, strain at a point-Mohr's circle for strain, Hydrostatic & Deviatorycomponents of stress, Elastic stress strainrelations.Elements of theory ofplasticity; Flow curve, True stress & true strain, Yield criteria for ductilemetals, Von Misses & Teresa yield criteria, combined stress tests. The yieldlocus,Anisotropyinyielding,Yield surface, levy-Misses, Prandtl-Reuss Stress-Strain relation, Classification offormingprocessesvariablesinmetalformingandtheiroptimizationAnalysisof deformation processes- Method based on homogeneous compression sliplinefieldtheory,Upperboundsandlowerbounds,Slabmethodofanalysis.	22
II	Flow stress determination, Hot working, Cold working, Strain rate effect,Friction and lubrication, Deformation zone geometry, Workability, Residualstress. Analysis of metal forming processes (only limited portion), Forging: Loadcalculationinplanestrainforging,Rolling:Forces&geometricalrelationshipinrolling,Rollingloadandtorqueincoldrolling,Von-Karmanworkequation,Extrusion: Analysisof extrusionprocess,extrusionpressure,Drawing: Drawingload	20

TextBooks:

- R.HWagoner,Metal FormingAnalysis,CambridgeUniversityPress
- G.W.Rowe,PrinciplesofIndustrial Metal workingprocesses,CBS publishersandDistributors
- B. L.Juneja,FundamentalsofMetal formingprocesses,Newageinternationalpublishers
- GhoshandA.K.Malik, ManufacturingScience, EastWestPress

ReferenceBooks:

- Johson&Mellor,VanNostrand: EngineeringPlasticity.
- Avitzur,McGrawHill:Metalworking.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:

Afterlearningthecoursethestudentsshouldbeableto:CO1
.Identifyvariousformingprocess;

CO2.
Identifyanddeterminevariousyieldcriteriausedinformingprocess;CO3.Lear
n mechanicsofforgingprocesses;

CO4. Learn mechanics of extraction
processes;CO5.Learn mechanicsof
drawingprocesses.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs / PSOs
CO1	PO1 / PSO2
CO2	PO2 / PSO2
CO3	PO1 / PSO2
CO4	PO2 / PSO2
CO5	PO1 / PSO2

BMEE0401INDUSTRIALENGINEERING

Objective:

- *Toenablethestudentsunderstandthedemandforecastingtechniquesandcosting.*
- *Toprovidestudentsaninsightintotheconceptsofindustrialengineeringandorganization.*
- *Tofamiliarizethestudentswithprinciplesofwork-studyandErgonomics.*
- *Tointroducestudentstovariousaspectsofplantdesignandmaterialsplanning.*

Credits:3 **L–T–P-J:3–0–0-0**

Module No.	Content	Teaching Hours
I	**IndustrialOrganization:**Concept,Scope,Objective,Functions,Techniques,&Role ofIndustrial Engineering. MeaningofProductivity,DifferenceBetweenProduction&Productivity,IndicesofProductivity,ReasonsofLowProductivity,Techniques to Improve Productivity. Types of Production, Plant Layout.**Demand Forecasting:** Demand variation, Factors influencing demand,JudgmentalForecast,Timeseries-Rollingaverage,WeightedMovingAverage,Exponentialsmoothing,casualforecast-Correlation,Linearregression,ForecastError. **WorkStudy:** Meaning &BenefitofWorkStudy, Method Study, Recording Techniques-Process Chart, Time scale chart,Flow&StringDiagram,Micro-MotionStudy,SIMOChart,Cycle&ChronoCycle Graph, Time Study- Performance Rating, Allowances, Computation of StandardTime,WorkSampling, PMTS. **MaterialHandling:**Introduction,Objectives,ElementsandPrinciplesofMaterial Handling. **QualityControl:**ProcessControl,SQCCharts,Single,DoubleandSequential AcceptanceSampling,QualityFunctionDeployment.	26
II	**Production Management:** Production Planning & Control, InventoryControl-TypesofInventory,CostAssociatedwithInventory,Deterministic Inventory Models, Inventory Control Techniques, Cost ofProduction,Brake-Even-Analysis. **AdvanceTopicsinProductionManagement:**TotalQualityManagement (TQM)- TQM Approach, Stages of implementation, TQMModel,JustInTime(JIT)Manufacturing–SevenWaste,BasicElements, JITPhilosophy,KanbanSyatem.	14

TextBooks:

- KhannaO.P.,"IndustrialEngineering&Management",DhanpatRai&Sons.
- ShankerRavi,"IndustrialEngineering",GalgotiaPVTLtd.
- TelsangMartand,"IndustrialEngineeringandProductionManagement",S.Chand,New Delhi

ReferenceBooks:

- KoontzH.&DonnelC.O.,“PrincipleofManagement&AnalysisofManagementFunctions”,Tata McGrawHillCo.
- MooreJ.,“ManufacturingManagement”,PrenticeHallEnglewoolcliffs:NewJersey.
-

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Onsuccessfulcompletionofthislab,thestudentswillbeableto:

- *CO1:ApplyconceptsofIndustrialEngineeringinthefieldofdifferentindustries.*
- *CO2:UnderstanddifferentconceptsregardingOrganizationandProductivityinindustries.*
- *CO3:Anabilitytoidentify,formulates,andsolvesengineeringproblemsbyanalyzingandinterpretingdata.*
- *CO4:Planningandcontrollingofproductionsystemanduseofmodernforecastingandmanagementtechniquesfordifferenttypesofindustries.*
- *CO5:Anabilitytodesign,develop,implement,andimproveintegratedsystemsthatincludepeople,materials,information, equipment, andenergy.*
- *CO6: An understanding of professional and ethical responsibility, ability to use the techniques, skills, andmodernengineeringtoolsnecessaryforengineering practice.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**Pos/PSOs**
CO1	PSO2,PO1,PO6
CO2	PSO2,PO1
CO3	PO2,PO9
CO4	PSO2,PO2,PO11
CO5	PSO1,PO3
CO6	PSO3,PO3,PO6,PO8

BMEE0402PRODUCTDESIGNANDDEVELOPMENT

Objectives:

- *TostudythebasicconceptsofProductdesignandDevelopment.*
- *Tostudytheapplicabilityofproductdesignand developmentinindustrialapplications.*
- *Tostudythe keyreasonsfordesign orredesign*.

Credits:03 **L–T–P:3–0–0**

Modul eNo.	**Content s**	**TeachingHours** (Approx.)
I	Classification/SpecificationsofProducts.Productlife cycle. Productmix,Introductiontoproductdesign,TheRoleandNatureofDesign,OldandNewDesignMethods,DesignbyEvolution.,DesignbyCraft,NeedBasedDevelopment,TechnologyBasedDevelopments,EconomicFeasibilityofDesign Concepts, Modern product development process,Innovativethinking, Morphologyof design. **Reliability:**ReliabilityConsiderations:ReliabilityAnalysisofSystems,BathTubCurve,ReliabilityofSystemsinSeriesand Parallel.FailureRate,MeanTimetoFailure(MTTF)andMeanTimeBetweenFailures (MTBF).	20
II	**DecisionTheory:**DecisionMakingUnderConditions of Certainty, Decision Making Under Conditions of Uncertainty,DecisionMakingUnderConditionsofRisk,MaximumLikelihoodCriterion,VariationofExpectedValueCriterion. **Break-Even Analysis**: Fixed and Variable Costs, Assumptions ofBreakEvenAnalysis,UtilityofBreakEvenAnalysis,Limitation ofBreakEvenAnalysis **Statistical Quality Control (SQC):** Advantages of StatisticalQualityControl,QualityControlCharts,TypesofControlChartsSuch as X(Bar)and R Chart,P Chart andC Chart. **Technological Forecasting**: Characteristics and Importance ofTechnological Forecasting,DifferentForecastingMethods, **Patents&IPActs-**Overview, Disclosurepreparation.	20

TextBooks:

- Chitab A.K.&Gupta R.C.,"*ProductDesign&Manufacturing*",PHI(EEE).
- UlrichK.T,andEppingerS.D,"*ProductDesignandDevelopment*",TataMcGrawHill

ReferenceBooks:

- StarrM.K.,“*ProductDesign &Decision Theory*”,PrenticeHall.
- CainC.D,“*EngineeringProductDesign*”,BusinessBooks.
- MayallW.H.Itiffe,“*IndustrialDesignforEngineers*”, TMH.
- J.ChristopherJones,“*DesignMethods–seedsofhumanfutures*”,JohnWiley&Sons.
- JamesBoyle,JenniferJenkins,INTELLECTUALPROPERTY:LAW&THEINFORMATIONSOCIETY -CASES&MATERIALS,

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Studentswillbeable to:

CO1. Identifyand analyzetheproduct designanddevelopmentprocessesinmanufacturingindustry.

CO2.Definethecomponentsandtheirfunctionsofproductdesignanddevelopmentprocessesandtheirrelationshipsfromconcepttocustomeroverwholeproductlifecycle.

CO3.Analyze,evaluateandapplythemethodologiesforproductdesign,developmentandmanagement.

CO4.Decisionmakingabilityofthestudentswillimprove,theycantaketherightdecisionsregardingtheproductwithouttheproperinformation.

CO5.Undertakeamethodicalapproachtothemanagementofproductdevelopmenttosatisfycustomerneeds.

CO6. Carryoutcostandbenefitanalysisthroughvariouscostmodels.

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs / PSOs
CO1	PO1 / PSO1
CO2	PO2 / PSO1
CO3	PO3 / PSO1
CO4	PO3 / PSO2
CO5	PO11/ PSO2
CO6	PO11/ PSO2

BMEE0403OPERATIONSRESEARCH

Pre-requisite:*IndustrialEngineering*

Objective:

- *ProvideknowledgeofOPTIMIZATIONapproaches*
- *TodevelopDecision-makingskills.*
- *Providescopetostudentstoresearchmethodsandlatesttrendsinoperationresearch.*
- *Tounderstandthevariousbusinesssituations.*

Credits:03 **L–T–P:3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:**BasicsofOperationsResearch,ApplicationArea,Models,AdvantagesandDisadvantagesofOperationsResearch. **LinearModels:** **Linear programming:** Problem Formulation, Graphical Method, SimplexMethod, Duality in LinearProgramming, Big M-Artificial Variable Method,Degeneracy. **AssignmentProblems:**MathematicalFormulation,HungarianMethodProblem, Degeneracyin Assignment Problem **Transportation:**Matrix Form, Basic Feasible Solution:- North west method,Leastcostmethod,Vogel'sapproximationmethod.OptimumSolution:-MODImethod,Unbalanced-Problems, **DynamicProgramming:**MultistageDecisionProblems&Solutions,Principle ofOptimality. **Game Theory:**Two Persons Zero Sum Game, Solution With/Without SaddlePoint,propertyof Dominance,Graphical methods	20
II	**Sequencing:**Introduction,Assumption,Johnson'sProcedureforNJobsonTwo MachinesandNJobson ThreeMachines. **Simulations:** Simulation V/S Mathematical Modeling, Monte-CarloSimulation,SimulationLanguages,Uses,Advantagesand Limitations. **InventoryModels:**Variouscostandconcepts,EOQ,Deterministicinventorymodels-productionmodel-Buffer stock **QueuingModels**:Introduction,PoissonandExponentialDistribution,SingleServer andMultiServersModels. **Networks:**BasicConcepts,Constructionofnetworks,RulesforNetworkDrawing,CPMCalculations. Pert Calculations Such As Different Times and Different Floats.Casestudybased2 Miniprojects.	20

TextBooks:

- *GuptaPremKumar,HiraD.S.,"OperationsResearch":S.Chand&Co.*
- *Taha,HamdyA.,"OperationsResearch":PrenticeHallInternationalPublications.*

ReferenceBooks:

- *Wagner,Claire,"PrinciplesofOperationsResearch":PrenticeHallInternationalPublications.*
- *Buffa,Edwood,"ProductionPlanningofOperationManagement":TMHPublications.*
- *Rao,S.S.,"OptimizationTechniques":WileyEasternLimited.*
- *Pradeep.p.Pai,"OperationResearch":OxforduniversityPress.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: **Aftercompletion of thecourse,studentwillbeableto:**

- **CO1:Toimpartknowledgeinconceptsandtoolsof OperationsResearch.**
- ***CO2:Applytheknowledge&toolsofoperationresearchinvariousindustries.***
- **CO3:Proficienttorecognizetheimportanceandvalueofmathematicalmodeling in solving practical problems in industry by linear programmingproblems.**
- ***CO4: Understand the mathematical tools that are needed to formulate &solvetransportationproblems forcost optimization.***
- **CO5: Understand the process of best strategy using decision making methodsunderuncertainty andgametheory.**
- ***CO6: Determine the optimum sequence of n job over 2 and 3 machining bysequencing.***
- **CO7:Understandtheconceptofprojectnetwork,projectscheduleandproject monitoring activitiesby usingCPMand PERTmethod.**

Mappingof CourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs)

COs	**POs/PSOs**
CO1	**PO1,PO2,PO6/PSO3**
CO2	**PO1,PO9/PSO3**
CO3	**PO2,PO11/PSO3**
CO4	**PO5,PO9,PO11/PSO3**
CO5	**PO3,PO4,PO10,PO12/PSO3**
CO6	**PO3,PO5/PSO3**
CO7	**PO8,PO11,PO12/PSO3**

BMEE0404VALUEENGINEERING

Pre-requisite:*IndustrialEngineering*

Objective

1. Understandtheimportanceofvalueengineeringanditsapplicationintheirrespectivefields
2. FamiliarizewiththeprocedureofValueanalysisandValueengineering
3. Implementationofvalueengineering.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**INTRODUCTION:** Meaning of Value Engineering (VE), Value and its types, Relationship between valuevis-a-visperson,timeandenvironment,HistoryofValueEngineering,ValueAnalysis,ValueManagement, Worldbodie sofValueEngineering&theiractivities, Multi-disciplinaryteamapproachinValueEngineeringstudy. **JOB PLANNING:**Introduction and comparison of jobplansin value engineering, FinanceandhumanrelationsinVE. **ORIENTATIONPHASE:**Trainingassociates in Value AnalysisandValueEngineering(VAVE).DifferenttrainingandcertificationsavailableinVAVE,Methodtoconduct VAVEstudies. **INFORMATIONPHASE**:InformationneededforVAVE,methodtocollectandanalyzeinformation,A B C Analysis, ParetoAnalysis,Breakevenanalysis. **FUNCTIONANALYSIS PHASE**:Breakdownitemintoelementsandsub-elements, Introduction to functions,practicesession,typesoffunctions(useandsellfunction),levelsoffunction(basicandsecondary),identifyvariousfunctions.	22
II	**FUNCTION ANALYSIS PHASE**: Elementsofcost,procedureforcostallocation,costallocationtofunction, concept of worth, process flow for determining worth, discussions on worth, meaning ofFAST, use of FAST, development history of FAST, different types of FAST. Ground rules of FAST,FASTdiagram **CREATIVEPHASE:**Definitionofcreativity,misconceptionsaboutcreativity and introduction tocreativetechniqueslikeTRIZ,3P,lateraladoptionandothers **EVALUATIONPHASE:**Selectioncriteria,feasibilityanalysis,weightedevaluationmethods,decisionmatrix. **RECOMMENDATIONPHASE**:Needforrecommendation,methodtomakepresentation,impactanalysisand justificationreport,implementationplan,presentationskills. **IMPLEMENTATIONPHASE**:Detaileddesign,verificationandvalidation,certification,changeimplementation. **AUDITPHASE**:Needforaudit,typesofaudit,howtoaudit.	22

TextBooks:

- *LawrenceD.Miles,TechniquesofValueAnalysisandEngineering,3rdEdition,NewYork*
- *KR.Chari,Valueengineering,NPC,NewDelhi*

ReferenceBooks:

- *SSIyer,ValueEngineering:AHow-toManual,NewageInternationalPublisher-2"dedition009*
- *AnilKumarMukhopadhaya,ValueEngineeringMastermind:FromConcepttoValueEngineeringCertification.SAGE,NewDelhi*

- *Del.LYonker,Valueengineeringanalysisandmethodology,CRCpress,NewYork*
- *Dr.M.A.Bulsara,Dr.H.R.Thakkar,ProductDesignandValueEngineering,charterpublishers,1st edition2015.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

Aftercompletionofthecourse,studentwillbeableto:

- **CO1:ToimpartknowledgeinconceptsandtoolsofValueEngineering.**
- ***CO2:Applytheknowledge&toolsofValueEngineeringinindustries.***
- **CO3:UnderstandtheDifferentphasesofvalueengineeringandtheirsequence.**
- ***CO4:Understandandapplythemethodsofjobplanning.***
- **CO5:Analyzetheproductdesign&developmentbyapplyingconceptofvalue engineering.**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program SpecificOutcomes(PSOs)

Cos	POs/PSOs
CO1	PO1,PO2,PO6/PSO2
CO2	PO1,PO9,PO11/PSO2
CO3	PO1,PO3/PSO2
CO4	PO1,PO3,PO5,PO9/PSO2
CO5	PO2,PO3,PO11/PSO2

BMEE0405SUPPLYCHAINMANAGEMENT

Pre-requisite:_IndustrialEngineering_

CourseObjectives:_Toimpartknowledgeandunderstandingtostudentson SupplyChainManagementanditsrelevancetotoday's businessdecisionmaking._

- _Develop an understanding of therole of supplychain in amarket-orientedsociety_
- _Examinethemajorfunctionsofsupplychain_
- _Provideanopportunityforcomprehensiveanalysisanddiscussionofkeycontemporaryissues_
- _andproblemsinsupplychainmanagement_
- _Examine the details of planning andcontrolprocesses insupplychainmanagement_

Credits:3 **L–T–P:3–0–0**

ModuleNo.	**Contents**	**TeachingHours** (Approx.)
I	**AppliedSupplyChainManagement:**Introduction,Definition, Objectives&Importanceofsupplychainmanagement,complexity&keyissues,Centralizedvs.decentralized systems, Drivers in SCM, SCM decisions andskills, Strategy formulation in SCM, , Bullwhip effect, Push-based,pullbasedsystems **Informationtechnologyinsupplychain:**Valueofinformation ,EnablingsupplychainthroughIT,Criticalbusiness processes and information systems -DBMS,benefits of ERPinformationsystem, RFID **StrategicSourcing:**Sourceevaluation,collaborativeperspective, Buyer-Supplier Relationship, Partner Selection,developofPartnership,importanceofinventory,imbalances,uncertainties,inventorycosts,inventory turnoverration	21
II	**Transportation decision:** Tradeoff, Modes ofTransportation,ModelsforTransportationandDistribution, Factors affecting Network Effectiveness, 3 PL advantages, Bar CodingVendoranalysismodel,CoordinatedSCM,ReverseVsforward supply chain, types of reverse flows, collaborativeSCM'sandCPFR,agilesystems,sourcesofvariability,characteristics,supplierinterface SupplyChainManagementandprofitability,qualitymanagement,masscustomizationandglobalization,ethical SupplyChains,e-businessandSCM,BalancedScoreCard,Benchmarking,Performance measurement	19

Text Books:

- R P Mohanty,S.G Deshmuki "SupplyChainManagement" Biztantra, NewDelhi,2005

- ChopraandMeindl,SupplyChainManagement2007
- JanatShah,SupplyChainManagement,2016

Reference Books:

- Bowersox,LogisticalManagement,Mc-GrawHill,2000
- SahayBS,SupplyChainManagementforGlobalCompetitiveness,MacmillanIndiaLtd.,New Delhi.
- ReguramG,RangarajN,LogisticsandSupplyChainManagementCasesandConcepts,MacmillanIndia Ltd., NewDelhi,1999.
- Coyle, Bradi&Longby, The Management of Business Logistics, 3rd Ed., WestPublishingCo.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Aftercompletionofcourse,thestudentwillbeableto:

- CO1:Become familiar with current supply chain management trends Understand and apply thecurrentsupplychaintheories,practicesandconceptsutilizingcaseproblemsandproblem-basedlearningsituations
- CO2:Developasoundunderstandingoftheimportantroleofsupplychainmanagementintoday'sbusinessenvironment
- CO3:Learntouseandapplycomputer-basedsupplychainoptimizationtoolsincludingtheuseofselectedstate ofthe artsupplychainsoftwaresuitescurrently used inbusiness
- CO4:Developandutilizecriticalmanagementskillssuchasnegotiating,workingeffectivelywithina diverse businessenvironment, ethical decisionmakingand useofinformationtechnology
- CO5:Demonstratetheuseofeffectivewrittenandoralcommunications,criticalthinking,teambuilding andpresentationskillsasapplied to businessproblems
- CO6:Successfullycompleteacaseprojectconcludingwithawrittenandoralpresentation ofthefindings

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2/PSO3
CO2	PO1/PSO2,PSO3
CO3	PO5/PSO3
CO4	PO8/PSO3
CO5	PO4/PSO3
CO6	PO3,PO4/PSO3

BMEE0406 APPLIEDERGONOMICS

Pre-requisite:*ProductDevelopment&Design*

Objective: Theobjectiveofthiscourseistointroduceindustrialergonomicsandthevastapplicationofergonomics in industryand designresearch forproductsystem.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:**DefinitionofErgonomics/HumanFactors.TheevolutionofErgonomics, reasons to use ergonomics, micro- and macro- ergonomics, performingergonomics,judging the effectivenessofergonomicsintervention. **HumanBody:**Humancapabilitiesandlimitationsintermsofengineering.Anthropometrical, Physiological,Psycho-socialconsiderationsinErgonomics. **Ergonomicsdesignmethodology:**Occupationalsafetyandstressatworkplace;Workstation design; Furniture and Environment factors affecting human performance;Designdevelopmentandusability evaluation. **OfficeWorkstation**: Theories of healthy standing and sitting, free posturing, ergonomicsdesignoftheofficecomputerworkstation. **Methods, Standards and Work Design:** Determination of work content, workstation,workmethods,andtimesrequiredforvariousoccupationaljobs/tasks.Designoftasks/jobs, workplace, and work environment to increase productivity, eliminate waste,anddecreaseoccupational injury/illness.	22
II	**Musculo-skeletalsystem**:Jointmotionstudy,Basicmodeloncalculationofbiomechanicalstressesonourbody. **Product Ergonomics:** Product ergonomics and design, design from the view point ofbiomechanics,Workpostureanalysis,staticanddynamicwork,thevisual,auditoryandthermal environment and their impact on design. design for the physically challenged.**Research technique:** Ergonomic data generation, interpretation and application ofstatisticalmethods.Caseanalysis. **Miniproject:**MiniProjectworkinvolvingergonomicdesignresearchforproductsystem.	18

TextBooks:

- M.S.SandersandErnestJ.McCormick:Humanfactors inengineeringanddesign,sixthEdi.McGraw-HillInternational Editions,1987.
- P.O. Astrand andK.Rodahl:Textbook of work physiology,McGrawHill,New York,1970.
- Konz SA & Johnson S. Work Design: Industrial Ergonomics. 6thEdition, Holcomb HathawayPublishers,2004.ISBN:1-890871-48-6

ReferenceBooks:

- R.SBridger, Introduction toErgonomics,McGraw-HillInc.,1995.
- G.SalvendyEd.,HandbookofHumanFactorsandErgonomics,JohnWileyandSons,1997.
- D.Chakrabarti,IndianAnthropometricDimensionsforErgonomicDesignPractice,NationalInstituteofDe

sign,Ahmedabad,1997.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Uponcompletionofthecourse,studentsshouldbeableto:

- CO1: *Apply basic knowledge of physical ergonomics such as physical load, anthropometry, biologicalvariationandbiomechanics.*
- CO2:*Explainandapplybasicknowledgeofcognitiveergonomicssuchasperception,memory,informationprocessing,attention,learning,decision-making,stress,mentalworkloadandmaltreatment,*
- CO3: *Apply basic knowledge of physical factors affecting human beings in relation to light, lighting,sound* andnoise,climateandvibrations.
- CO4: *Identify and relate factors affecting human performance in the interaction with products, analyseand reflect on the results of ergonomic analysis of product systems and draw conclusions and giverecommendationsforproductimprovement.*
- CO5:*Presentacompletedergonomic analysisofproductandworkplace orallyandinwriting.*

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

Cos	POs/PSOs
CO1	PO3/PSO1
CO2	PO2/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1

BMEE0501ROBOTICS&FMS

Pre-requisite:*IndustrialEngineering*

Objective: To introduce the foundations of robotics. Also, a course on Robotics must use one or more softwaretonotonlyvisualizethemotionandcharacteristicsofrobotsbutalsotoanalyser/synthesize/designrobotsforagivenapplication.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**FundamentalsofRobotTechnology**: Robot definition, automation and robotics, Robot anatomy, Work volume, Drivesystems.Controlsystemsanddynamicperformance.Accuracyandrepeatability. Sensors and actuators used in robotics. Machine Vision, Robotconfigurations,Pathcontrol.Introductiontorobotlanguages.Applications;Types (Mobile,Parallel);Serial:Cartesian,Cylindrical,etc.;SocialIssues **Robot Kinematics**: Mapping, Homogeneous transformations, Rotation matrix,ForwardKinematics(DHNotation)andinversekinematics:Closedformsolution.**Robot Differential Motion:** Linear and Angular velocity of rigid link,Velocityalonglink,Maipulatorjacobian,Statics:Useofjacobian.	20
II	**Robot Dynamics:** Lagrangian Mechanics,LagrangianFormulationandnumericals.Dynamics,Newton-EulerRecursiveAlgorithm,Simulation.Euler-LagrangeEquationsofmotion/Anyoneotherformulation like using Decoupled Natural Orthogonal Complements (DeNOC)**Endeffectors**:Mechanicalandothertypesofgrippers.Toolsasendeffectors.Robotand effectorinterface. Gripperselectionanddesign. **ApplicationsforManufacturing.**Flexibleautomation.Robotcelllayouts.Machineinterference.Otherconsiderationsinworkcelldesign.Workcellcontrol, interlocks. Robot cycle time analysis. Mechanical design of robot links.Typical applications of robots in material transfer, machine loading/unloading;processing operations;assemblyandinspection.	20

TextBook:

- R.K.Mittal,I.J.Nagrath,"Robotics&Control",TataMcGraw&Hills,2005.
- MikellPGroover,MitchellWeiss "IndustrialRobotics:Technology,ProgrammingandApplication"TataMcGraw&Hills,2009.
- S.K.Saha,"IntroductiontoRobotics",2ndEdition,McGraw-HillEducation,NewDelhi,2014

ReferenceBooks:

- JohnJ.Craig;"IntroductiontoRoboticsMechanics&Control",PearsonEducation,2004.
- RobertJ.Schilling,"FundamentalsofRobotics,analysis&Control",PrenticeHall(I)P.Ltd.,2002
- MarkW.Spong,SethHutchinson,M.Vidyasagar"RobotModelingandControl"JohnWiley2ndEd
- JSrinivasan,R.V.Dukkipati,K.Ramji,"Roboticscontrol&programming",Narosa.
- Ghosal,Ashitava,"Robotics:FundamentalConceptsandAnalysis,"OxfordUniversityPress,2006
- M.Murray,M.,Li,Zexiang,Sastry,S.S.,"AMathematicalIntroductiontoRoboticManipulation,"CRCPress,

1994
- Tsai,L.W.,“RobotAnalysis:TheMechanicsofSerial&ParallelManipulators,”Wiley1999
- Niku,S.B.,“IntroductiontoRobotics:Analysis,Systems,Applications”,PrenticeHall,2001

Outcome:

CO1:Understandthefundamentalsofrobottechnologyfunctionssuchasdynamicperformance,Sensors and actuators used in robotics.

CO2:KnowledgeofMachineVision,Robotconfigurations,Pathcontrollanguages.CO3: Understand of Cartesian, cylindrical, spherical and various application in roboticsCO4:Knowledgeofmodelingforkinematicanddynamicsverificationofanyrobotstructureusingsuitablesoftware

CO5:Understandrobotdifferentialmotion, grippersandendeffectors

CO6:Understandofvarioussensors,FMSintegrationandprogrammingforlinearandnonlinearpathin roboticapplications

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PO3/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEE0182ROBOTICS&FMSLAB

Credits:01 **L–T–P-J:0–0–2-0**

Module No.	Content	Teaching Hours
I	• Developmentofmultiplesensorfusionuseinvariousrobotic application • DemonstrationofarticulatedSCARA,PUMAandotherr obots. • DemonstrationofCartesian,cylindrical,sphericalandvariou sapplicationin robotics • Virtualmodelingforkinematicanddynamicsverificationof anyrobot structureusingsuitable software • Forward, inverse kinematics and trajectory planning forPUMA, SCARA and Stanford using robotics tool box forMATLAB	12
II	• Studyof various sensors integration in roboticapplications • Programming for linear and non linear path using roboticapplication • Simulation of planner and spatial mechanism using multi bodydynamicssoftware. • Design,modelingandanalysisofdifferenttypesofgrippersa ndmanipulators. • Tointroduceanddemonstrateflexiblemanufacturingsystem • TostudyandintegratevariousFMScomponentlikemachines and actuators in differentapplication offactoryautomation • StudyandprogrammingofsensorsintegrationinvariousFMS applications	12

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: At theend ofthiscoursestudents willbe able to

CO1:Understandthefunctionsofmultiplesensorfusionuseinvariousroboticapplication.

CO2:KnowledgeofarticulatedSCARA, PUMAand otherrobots.

CO3:UnderstandofCartesian,cylindrical,sphericalandvariousapplicationinrobotics

CO4:Knowledgeofmodelingforkinematicanddynamicsverificationofanyrobotstructureusingsuitablesoftware

CO5:Knowledgeofforward,inversekinematicsandtrajectoryplanningforPUMA,SCARA and Stanford usingrobotics toolboxforMATLAB.

CO6:Understandofvarioussensors,FMSintegrationandprogrammingforlinearandnonlinearpathin roboticapplications

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO3/PO12/PSO3
CO3	PO1/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEE0196PROJECTBASEDROBOTICS&FMS LAB

Credits:02 **L–T–P-J:0–0–0-8**

Module No.	Content	Teaching Hours
	• Study of DTMF Controlled Robot without Microcontroller: The mainaimofthisprojectistocontrolaroboticvehiclebygivingtheinstruction through mobile phone using DTMF technology. This canbeusedforsurveillancesystemsandindustrialapplications. • Study of Microcontroller Based Line Following Robot : This projectillustrates the concept of tracking or following the path specified to aroboticvehicleusingAVRmicrocontroller.ThisprojectusesIRsensorto detect thepath specified bytheuser. • Study of PC Controlled Human Detection Robot: This project aims todetect the humans through a robotic vehicle by using IR sensors andmicrocontroller unit. This project is very helpful in the time of earthquakesto detect the personnel. • StudyofMetalDetectorRobotUsingMicrocontroller:AMetaldetectorrobotisusefultosensethemetalsinthepathaheadofit.This will be necessary requirement in case land mines detection. Sothis project meets the requirement with simple microcontroller basedrobot. • Study of Obstacle Avoiding Robot: This is an autonomous intelligentrobotwhichisbuiltwithinfraredsensorstosensetheobstaclescoming in the path of the robot and correspondingly changes thedirectionofthe robot. • StudyofAutomaticFireSensingandExtinguishingRobot:Thisproject aims to develop a multi flame sensor based fire fighting robot.If the fire takes place, the robot moves towards the fired area andstartssprinklingthewaterfrom waterpump attachedtoit. • StudyofAutomatedSystemDesignforMetroTrain:Thisisanautomated system for a metro train which announces the station nameand displays the relevant information when train arrives at particularstation.Inthis,RFIDtags areusedfortrackingthestationdata. • Study of Color Guided Material Handling Robot: The main idea of	24

	thisprojectistobuildacolordetectingrobotwhichseparatestheobjects thataremovingonaconveyerbeltinanindustry.Thisprojectuses	
	MATLABtodevelopcolordetectivealgorithm. • Study of Arduino Based Smart Boat with Obstacle Detection: This is asimpleDIYprojectwhichhelps todesignaboatwithadditionalfeatureslikelight guidedcontrolandobstacledetection. • Study of Design of Microcontroller Based Edge Avoider Robot : Thisproject implements a robot which can avoid edge by detecting earlyandtakesfurtheractionintime.Thisprojectalsoincludespathfinding,obstacledetectionand linefollowercapabilities.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: At theend ofthiscoursestudents willbe able to

CO1:Understandthefunctionsofmultiplesensorfusionuseinvariousroboticapplication.

CO2:KnowledgeofDTMFControlledRobotwithoutMicrocontroller,PUMAandotherrobots.

CO3:UnderstandtheworkingofAutomatic FireSensingandExtinguishingRobot

CO4:KnowledgeofmodelingforkinematicanddynamicsverificationofstructureusingsuitablesoftwareforObstacle AvoidingRobot.

CO5:Knowledgeofforward,inversekinematicsandtrajectoryplanningforPUMA,SCARA and Stanford usingrobotics toolboxforMATLAB.

CO6:UnderstandthevarioussensorsandtheirapplicationsinMetalDetectorRobotUsing Microcontroller.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs

CO1	PO1/PSO12/PSO2,PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO3
CO4	PO1/PO2/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

BMEE0502:INDUSTRIALAUTOMATION&CONTROLSYSTEMS

Pre-requisite:*IndustrialEngineering*

Objective: Introductiontotheconceptofindustrialautomation,scopeofautomationandstudyofsocio-economic effects. Introduction to the fluid power control and study of the different fluid power systems working.Introduction to the automated material handling system used in automated industry. Study of the workingprinciplemechatronics devicesanddifferenttypesofcontrollers.Introductiontothecontrolsystems

Credits:03 **L–T–P:3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:**Concept and Scope of Industrial Automation, Socio-EconomicConsiderations,AndPneumaticLogicCircuits:Un-ComplementationAlgorithm. **Fluid Power Control:**Fluid Power Control Elements and Standard GraphicalSymbols for Them, Construction and Performance of Fluid Power Generators,Hydraulic&PneumaticCylinders-Construction,DesignandMounting,Hydraulic & Pneumatic Valves for Pressure, Flow & Direction Control, ServoValves and Simple Servo Systems With Mechanical Feedback, Simple HydraulicandPneumaticCircuits. **HighVolumeProductionSystems:**TransferDevices&Feeder,Classification, Construction & Application, Automated Flow Lines, Analysis ofAutomatedFlowLinesforReliabilityandEfficiency,AssemblySystems.	22
II	**Mechatronics:**MechanicalSystemInterfacing,SimpleMechatronicsDevices:Servo Motors, Stepping Motors, DC Motors, Analog / Digital Convertors.TypesandFunctionofControllers. Mathematical Modeling of Physical System and Concept of Transfer FunctionSystem.RepresentationThroughBlockDiagramandSignalFlowGraph. Time DomainResponseAnalysisUnderTransientInput&FrequencyDomainAnalysis Root - LocusTechniques,BodePlot.	18

TextBooks:

- Nagrath&Gopal"*ControlSystem*", McGrawHillEducation;4thedition,2012.
- MajumdarS.R.,"*PneumaticSystems*",TataMcGrawHill,2017
- SundaramK.Shanmuga,"HydraulicandPneumaticControls",SChand&Company;1stEdition2006
- JagadeeshaT,"HydraulicsandPneumatics",DreamtechPress,2019

ReferenceBooks:

- EspositoA., "*FluidPowerwithApplications*",PearsonEducationIndia;7thedition,2013
- Groover,M.P.,"*Automation,ProductionSystems&ComputerIntegratedManufacturing*",Pearson Education;Fourthedition, 2016.

- NormanS.Nise, “*ControlsystemEngineering*”Willey,2018.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: Aftercompletionofcourse,thestudent willbeableto:

- **CO1:Understand**theConstruction,DesignandMounting,Hydraulic&PneumaticValvesforPressure,Flow&DirectionControl,ServoValvesandSimpleServoSystemsWithMechanicalFeedback
- **CO2:**Providehydraulic**solutions**fordesigningautomatedsystems.
- **CO3:Understand**deviseAssemblyautomatedsystemsusingfeeders,orienteersandescapementdevices
- **CO4:Understand** the principle and construction of ServoMotors,SteppingMotors,DCMotorsandAnalog/DigitalConvertors.TypesandFunctionof Controllers.
- **CO5:Design**andimplementelectro-pneumatic/hydraulicsolutionsforautomatedsystems.
- **CO6:Apply** the Mathematical Modeling of Physical System and Concept of Transfer FunctionSystem

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/ PSO3
CO2	PO1/ PSO3
CO3	PO1/ PSO3
CO4	PO4/ PSO3
CO5	PO1/ PSO3
CO6	PO1,PO4/PSO3

BMEE0504ENGINEERINGSYSTEMMODELLINGANDSIMULATION

Pre-requisite:*IndustrialEngineering*

Objective: Tointroducethestudentsabouttheknowledgeofbasicanddynamicsystemmodelsofengineeringandsimulation system.

Credits:03 **L–T–P:3–0–0**

Module No.	Content	Teaching Hours
I	**BasicSystemmodels:**Mathematicalmodels,Mechanicalsystembuildingblocks, Electrical system building block, fluid system building block, thermalsystem buildingblock. **SystemModels:**Engineeringsystems,Rotationaltranslationalsystems,Electro-mechanicalsystems, linearity,HydraulicMechanicalsystems. **DynamicResponseofSystems:** Modellingdynamicsystems,Terminology,Firstordersystems,secondordersystems, performance measure of second order systems, system identification.**System Transfer Functions:** The transfer function, first order systems, second order systems, systems inseries,systemswithfeedbackloops,effectofpolelocationontransientresponse.	19
II	**Mechanical Event Simulation (Finite Element modelling and Analysis):**Introduction,Generalprocedureoffiniteelementmethod,finiteelementanalysis,iso-parametricevaluationofelementmatrices,finiteelementmodelling,meshgeneration,designandengineeringapplications.IntroductiontoProEsoftware-Mechanica&dynamicsimulation module. **SystemSimulation:** Introduction, Review of probability and statistics, managing the event calendarina discreteeventsimulationmodel,modellinginputdata. Generation of random numbers and variates, generic features and introductionto Arena Software, Real world applications of simulation, discrete continuoussimulation,verificationandvalidationofsimulation models.	19

Text Book:

- W.Bolton,“Mechatronics–ElectroniccontrolsystemsinMechanical&ElectricalEngineering”,PearsonEducationLtd.1868
- IbrahimZeid,“CAD/CAMTheoryandPractice”,TataMcGraw-HillPublishingCompanyLimited.1991
- SankarSengupta,SystemSimulationandmodelling, Pearson.2013

Reference Books:

- Deo,Narsingh,MillicanCharlesE.,”SystemSimulationWithDigitalComputer”,PHI.1978
- Gordon,Geoffrey,SystemSimulation,PHI.1977
- P.Radhakrishnan,SSubramanyan,V.Raju,CAD/CAM/CIM,NewAgeInternationalPublishers.2008

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Uponsuccessfulcompletionofthiscourse,thestudentwillbeableto:

- CO1:Describetheroleofimportantelementsofdiscrete eventsimulationandmodelingparadigm.
- CO2:Conceptualizerealworldsituationsrelatedtosystemsdevelopment decisions,originatingfromsourcerequirementsand goals.
- CO3:Developskillstoapplysimulationsoftwaretoconstructandexecutegoal-driven systemmodels.
- Interpretthemodelandapplytheresultstoresolvecriticalissuesin arealworldenvironment.
- CO4:*UnderstandthenumericalmethodsinvolvedinFiniteElementTheory.*
- CO5:*Understandtheroleandsignificanceofshapefunctionsinfiniteelementformulationsanduselinear,quadratic, andcubicshapefunctionsfor interpolation.*
- CO6:*RecognizesourcesoferrorsinFEA.*

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs):

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO3/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1
CO6	PO5/PSO1

BMEO0001TOTALQUALITYMANAGEMENT

Objective: *Study of total quality management will enable the students to develop their mental horizon byenhancing their knowledge and skills which will embed organizational skill & it would be overall beneficial for anyorganization. The main objective is to provide students with quality, organizational and people management skillsandtechniquestoenablethemtomakeasignificantcontributiontoanorganization'squalitypolicy.*

Credits:04 **L–T–P:3–1–0**

Module No.	Contents	TeachingHours
I	**Introduction:** Definition of Quality & Total Quality, World Scenario, QualityEducation, Drivers of Quality, Principles of Quality Management, Internal andExternal Customers, Vision, Mission, Objectives & Targets, Ten Principles ofQuality Management, Evaluation of TQM, Stages of Implementation of TQM, TQMModels. **Quality Planning:** SWOT Analysis, Strategic Planning, Organizational Culture,ManagementofChange. **CustomerOrientation:** Customer Focus,Customer SatisfactionModels,Customer Retention, Measurement of Customer Satisfaction, Quality FunctionDeployment. **QualitySolving Tools:** Process of Solving Problems – ConventionalMethods,7ModernManagementTools. **Continuous Improvement Strategies:** Deming Wheel, Zero Defect Concept,Benchmarking,SixSigma(6σ),Preventive Techniques–FailureMode&EffectAnalysis(FMEA),FiveSofHousekeeping,TimeManagement, TotalProductiveMaintenance	20
II	**Human Dimensions of TQM:** Top Management Commitment, Leadership forTQM, Motivational Strategies, Quality Circles, Team Development & Building,CommunicationandTransactionalAnalysis. **Quality Certification:** ISO 9000 Quality Management System (QMS), ISO14000Series,Qs9000Series,QualityAuditing,QualityAwards,QualityCertifyingAgencies,BusinessExcellenceModels. **Cost of Quality**- Prevention Cost, Appraisal Cost, Internal FailureCost,External Failure Cost, TQM Roadmap, How TQM Fails, TQM ImplementationStrategies. **ContributionofTQMGurus:**W.EdwardsDeming,JuranCrosby,Ishikawa,KaisenandTheirTheoriesforTotalQuality.	20

TextBooks:

- SuganthiL.,A.SamuelAnand,"TotalQualityManagement",PHILearning.
- BediKanishka,"QualityManagement",OxfordUniversityPress.

ReferenceBooks:

- JuranJ.M.,M.GrynaFranic,"QualityPlanningandAnalysis",TataMcGrawHillEdition.
- KumarS.,"TotalQualityManagement",UniversitySciencePress.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Attheendofthecoursethestudentshouldbeableto:*

- *Explainqualityconceptsregardingbasicandadvancedquality.*
- *Describetools&techniques,qualitymanagementsystems,qualityexcellencemethodologies.*
- *Explain continuous improvement methodologies, to the human development and motivation of peopleacross an organization.*
- *DescribeISOqualitystandardusedinindustries.*
- *Understandandexplainconceptofcostofquality.*
- *Illustratecontributionof philosopherlikeDeming,CrossbyIshikawa&KaiseninfieldofTQM.*

MappingofCourseOutcomes(Cos)withProgramOutcomes(Pos)andProgramOutcomes(PSOs):

COs	POs/PSOs
CO1	PO4/PSO2
CO2	PO2/PSO2
CO3	PO1/PSO2
CO4	PO7/PSO2
CO5	PO2/PSO2
CO6	PO6/PSO2

BMEO0002ENERGYCONSERVATIONANDMANAGEMENT

Objective: The main objective of this course is to understand the principles associated with effective energymanagement and to apply these principles in the day-to-day life. To gain exposure to energy auditing, to identifyenergy conservation opportunities in various industrial processes and to evaluate the performance of boilers,furnacesandotherenergyintensiveequipment/processes.

Credits:04 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **INTRODUCTION:** Principles of energy management. Managerial organization,Functionalareasfori)manufacturingindustry,ii)Processindustry,iii)Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating,Organizingandmanaging energymanagementprograms **ENERGY AUDIT:** Definition and concepts. Types of energy audits, Basic energyconcepts,Resourcesforplantenergystudies.Datagathering,Analyticaltechniques.**EnergyConservation:**Technologiesforenergyconservation,Designforconservationofenergymaterials,Energyflownetworks.Criticalassessmentof energy usage. Formulation of objectives and constrains, Synthesis of alternativeoptionsandtechnicalanalysisof options.Processintegration.	23
II	**Unit-II** **ENERGYEFFICIENCY:**FuelsandCombustion-Boilers-SteamSystem-Furnaces -InsulationandRefractory-FBCBoilers-Cogeneration-Wasteheatrecovery,DieselGeneratingSystem. **ENERGYPERFORMANCEASSESSMENT:**EquipmentandUtilitysystems-Boilers-Furnaces-Cogeneration, Turbines (Gas, Steam)- Heat Exchangers-ElectricMotors and Variable Speed, Drives-Fans and Blowers-Water Pumps-Compressors.**ALTERNATIVE ENERGY SOURCES:** Solar energy: Types of devices for solarenergycollections,Thermalstoragesystem,Controlsystems.WindEnergy, Availability,WindDevices,WindCharacteristics,performanceofturbinesandsystems. WasteMinimizationandResourceConservation.	22

TextBooks:

- H.KoontzandCyrillDonnel"Management" McGrawHill
- S.C.Kuchhal"FinancialManagement"ChaitanyaPublishingHouse.

ReferenceBooks:

- W. C., Turner and S. Doty "Energy Management Hand Book" FairmontPress, 2009, 7thedition.
- C.BSmith"EnergyManagementPrinciples"PergamonPress,2007
- W.RMurphy"EnergyManagement"Elsevier,2007.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

- *CO1:Understandingofenergyconservationand identificationofenergyconservation,opportunitiesinvariousindustrialprocesses.*
- *CO2:Knowledgeofvarioustoolsandcomponentsenergyauditing.*
- *CO3:Abilitytoevaluate theperformanceofindustrialboilers,furnacesetc.bydirectandindirectmethods.*
- *CO4:toinvestigatecogeneration inindustryandwasteheatrecoverytechniquesanddevices.*
- *CO5:Toconductenergyauditsindomesticandsmallindustries.*
- *CO6:Applyknowledgetodevelopmodelandprototypeswhichcanrecoverwasteheatforenergyefficiency.*

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PSO1
CO2	PO1,PO3,PSO1
CO3	PO4,PO5,PSO1
CO4	PO4,PO5,PSO1
CO5	PO4,PO5,PO6,PSO1
CO6	PO4,PO5,PO6,PO7,PSO1,PSO2

BMEO0003 SMARTMATERIALS

Objective:

Studentswillbeabletounderstandthevarietyofsmartmaterials,theirapplicationandadvantages. Theywillalsolearn compositematerials,theirmanufacturingprocessesandtestingmethods.

Credits:04 **L–T–P:3–1–0**

ModuleNo.	Content	Teaching Hours
I	**Introduction:**ClassificationsofEngineeringMaterials,Conceptofcomposite materials, Matrix materials, Functions of a Matrix, DesiredPropertiesofaMatrix,PolymerMatrix(ThermosetsandThermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, GlassMatrixetc.TypesofReinforcements/Fibers:RoleandSelectionorreinforcement materials, Types of fibres, Glass fibers, Carbon fibers,Aramidfibers,Metalfibers,Aluminafibers,BoronFibers,Siliconcarbidefibers,Quartz andSilica fibers, Multiphasefibers,Whiskers,Flakes etc., Mechanical properties of fibres. Material properties that canbeimprovedbyformingacompositematerialanditsengineeringpotential **Various types of composites:** Classification based on Matrix Material:Organic Matrix composites, Polymer matrix composites (PMC), CarbonmatrixCompositesorCarbon-CarbonComposites,Metalmatrix composites(MMC),Ceramicmatrixcomposites(CMC);	23
II	Classification based on reinforcements: Fiber Reinforced Composites,FiberReinforcedPolymer(FRP)Composites,LaminarComposites,ParticulateComposites,ComparisonwithMetals,Advantages&limitationsof Composites **Fabricationmethods:**ProcessingofCompositeMaterials:Overallconsiderations, Autoclave curing, Other Manufacturing Processes likefilamentwelding,compressionmolding,resin-transplantmethod,pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrixperforms, Manufacturing Techniques: Tooling and Specialty materials,Releaseagents,Peelplies,releasefilmsandfabrics,Bleederandbreatherplies, baggingfilms **TestingofComposites:**Mechanicaltestingofcomposites,tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminarsheartesting, Fracture testingetc.	22

Text/ReferenceBooks:

- ThomasJ.BrunoandRyanDeacon,“Vol.10:Materialscharacterization”:ASMhandbook,2019.
- G.Dieter,“MechanicalMetallurgy”:Mc-GrawHillEducation,1961.

- R.E.SpeyerandMarcelDecker,“ThermalAnalysisofMaterials”:CRCPress,1993.
- A.KBhargava,“EngineeringMaterials:Polymers,CeramicsandComposites”:PrenticeHallofIndia, 2005.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

CO1:Understandingofsmartmaterials,manufacturingprocesses,advantagesandapplications.

- CO2: Identify and Evaluate the properties of fiber reinforcements, particulates, matrix materialsandcommercialcomposites.
- CO3:Developcompetencyinoneormorecommoncompositemanufacturingtechniques andbeabletoselectappropriatetechniqueformanufactureofcompositeproducts.
- CO4: Analyze and understand the mechanical properties and mechanics of load transfer frommatrixtofibers.
- CO5: Understand and predict the mechanical performance and failure behaviour of theComposites.
- CO6:Apply theknowledgeofmanufacturingmethodsandcompositemechanicalperformanceofa given composites designproject.
- CO7:To understandthedifferenttestingmethods/Characterizationofsmartmaterials.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO1/PO4/PO5/PSO1/PSO2/PSO3
CO3	PO1/PSO2
CO4	PO1/PSO1
CO5	PO1/PO4/PSO3
CO6	PO1/PO2/PSO2/PSO3
CO7	PO1/PSO2/PSO3

BMEO0004PROJECTMANAGEMENT

Objective: The main objectives of project management are as follows: Understand exactly what a project ismeant to do and what it is meant to deliver. To learn the scope, timescales, cost and quality of a project. How tomaintain a schedule and project plan. To estimate the cost of project. Different finance institute available forfinancial add. Deliver the agreed outcomes of the project to the right scope, timescales, cost and quality. Providecommunications, reports and progress updates throughout the lifecycle of the project. To let students know howtomanagerisks, issuesand dependencies

Credits:03 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Project Characteristics, Attributes of A Good Project Manager,TaxonomyofProjects. **ProjectIdentification&Formation:**ProjectIdentification,DemandForecasting, Project Preparation, Zero Based Project Formulation, PreliminaryProjectReport,Comparison ofProjectAlternatives. **Project Appraisal:** Technical Appraisal, Commercial Appraisal, EconomicalAppraisal, Management Appraisal, Social Cost Benefit Analysis, NPV, IRR, BCR,NBCR. **FinancingofProjects:**EstimationofCostComponentsofProjects.Sources of Finances, Role of Financial Institutions, Cash Inflow and Cash Outflow, Cost ofCapital.	20
II	**ProjectPlanning&Scheduling:**SchedulingTechniques,PERT&CPM,NetworkPreparation,UpdatingNetwork,LineofBalanceTechnique,PerformanceAnalysisofProjects,CostVsTimeofCompletion,NormalTimeand Crash Time, Resource Allocation Techniques, Work Breakdown Structure.**ProjectContracts:**TypesofContract,Sub-Contract,Tenders&TypesofPaymenttoContractors. **ComputerAidedProjectManagement:**EssentialRequirementsofSoftware's, Software Packages, Enterprise-Wide Project Management, SpreadSheets. ProjectOrganization,PostProjectEvaluation,ProjectSickness–Causes,Predictionof Causes,Rehabilitation,ProjectAudit,Risk Analysis.	20

TextBooks:

- NagarajanK.,*ProjectManagement*,NewAgeInternationalPublishers.
- PanneerselvamR.&SenthilkumarP.,*ProjectManagement*,PHILearning.

ReferenceBooks:

- PatelBhaveshM,*ProjectManagement*,VikasPublishingHome.
- ScelharamanS.&RamnathVijay,*ProjectManagement*,Breweries;Education.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: **Aftercompletionofthe course,studentwillbeableto:**

- **CO1:UnderstandtheprojectcharacteristicsandTaxonomyofProject.**
- ***CO2:ApplytheknowledgeofDemandForecastinginmanagingthevarious projects***
- **CO3:UnderstandtheTechnical,Commercial,EconomicalandManagementAp praisal**
- ***CO4:Understandtheconceptofprojectnetwork,projectscheduleandproj ectmonitoringactivities byusing CPMandPERTmethod.***
- **CO5:proficientlyhandlethevarioussoftwarepackagesformanagingtheproject.**
- ***CO6: Determine the cost components of Projects and identify different Sources ofFinances***

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program SpecificOutcomes(PSOs)

Cos	**POs/PSOs**
CO1	**PO1/PSO2**
CO2	**PO1,PO2,PO5,PO11/PSO2**
CO3	**PO1,PO11/PSO2**
CO4	**PO8,PO11,PO12/PSO3**
CO5	**PO5,PO11/PSO2**
CO6	**PO1,PO4/PSO2**

BMEO0005RELIABILITYANDMAINTENANCEENGINEERING

Objective: The objective of the course is to provide the students with the fundamental concepts, maintenanceworkload analysis and calculations, maintenance work scheduling the necessary knowledge and the basic skillsrelatedtosystemreliabilityand systemsmaintenancefunctions

Credits:03 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	Maintenance Management,Production Maintenance System, Objectives andFunctions, Forms, Policy, Planning, Organization, Economics of Maintenance,EvaluationofMaintenance Management. **MaintenanceStrategies:**BreakDownMaintenance,PreventiveMaintenance,PlannedMaintenance,MaintenanceProgramme,JobReport,Strategies. Design Out Maintenance, Planned Lubrication, Total Productive Maintenance,ZeroBreakDownManpowerPlanning,MaterialsPlanning,SpareParts PlanningandControl.	19
II	**ReliabilityEngineering:**Introduction,OperatingLifeCycle,Reliability,Failure Data Analysis, Failure Rate Curve, Hazard Models, Elements in Series,Parallel,Mix,LogicDiagrams,ImprovingReliability,Redundancy-Element,Unit,Standby,Maintainability,Availability,ReliabilityandMaintainabilityTradeOff. BreakDownMaintenancePlanning,ReplacementPlanningMaintainorReplaceDecision,ReplacementModels/Decisions,Individual,GroupReplacement, ReplacementinAnticipationofFailure. **ConditionMonitoring:**ObjectivesandTechniquesofConditionMonitoring.	21

TextBook:

- R. C. Mishra and K. Pathak, "*Maintenance Engineering & Management*": Prentice Hall of India, NewDelhi,2015.
- A. K. Gupta, "*Reliability Maintenance & Safety Engineering*": University Science, Press New Delhi,2009.

ReferenceBooks:

1. Dr.A.K.Gupta,"ReliabilityMaintenance&SafetyEngineering":UniversitySciencePressNewDelhi,2009.
2. KellyandM.J.Harris,"ManagementofIndustrialMaintenance":Boston:Newnes-Butterworths,1979.
3. B.S.Dhillon,"EngineeringMaintainability:HowtoDesignforReliabilityandEasyMaintenance":PrenticeHall ofIndia,New Delhi,1999.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

Aftercompletionofcourse,the student willbe ableto:

- CO1:Understandmaintenanceobjectivesandevaluatemaintenancestrategiesforprocessp lantapplications.
- CO2: Evaluate maintenanceschedules and assess the corresponding risks with appropriate tools&techniques.
- CO3: Understand the concept of maintainability & availability and different techniques availableto improvemaintainability &availability.
- CO4:Todevelopthetotaloptimumcostmodelforamaintenanceproblem.
- CO5: Understand the concept of reliability & its techniques for estimating reliability andcharacteristicsofcomponents/systems.
- CO6:Understandandapplytheconceptof reliabilitycentered maintenance(RCM) and advantagesforacompanyemployingthem.
- CO7: Understand and apply the concept of condition monitoring techniques & its data forpredictivemaintenance.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO1/PO5/PSO2
CO3	PO1/PSO2
CO4	PO3/PSO1
CO5	PO4/PSO2
CO6	PO6/PSO2/PSO3
CO7	PO4/PSO2

BMEO0006 MECHATRONICS

Objective: Mechatronicsisthecombinationofmechanicalandelectronicsautomationandcomputers.Nowadays all the mechanical machines have been made computer controlled. The Subject details the basichardware and software elements used for proper and successful operation of various equipment. The knowledgeofthissubjectwillbehelpfultostudentswhileworking inindustries.

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Automated Manufacturing System, need of Automation, elementsofAutomation,levelsofAutomation,Automationstrategies,advantages&disadvantagesofAutomation,CAD/CAM,CIM,FMSand CNCsystem. **MechatronicsSystem:**ElementsofMechatronicssystem,levelsofMechatronicssystem,MechatronicsDesignProcess,SystemandControl,feedback Principle, real time Mechatronics system and application, advantagesanddisadvantagesof Mechatronicssystem. **MechanicalActuatingSystems:**Typesofmotion,Degreesoffreedom,constraints, Kinematic Chains, Cam, Gear and gear trains, Ratchet and pawl Beltdrive,chain drive,bearing,preloading. Hydraulic&PneumaticActuationSystems:Fluidpowersystems,hydraulicsystems, Pneumatic systems, system structure and signal flow, hydraulic pumpsandPressureControlValves,aircompressorsandtreatment,Cylinders, DirectionControlValves,RotaryActuators.	20
II	**Electrical Actuation Systems:** Switching Devices, Mechanical Switches – SPST,SPDT, DPDT, Relays, solenoid operating Valve, Solenoid Operated Hydraulic andPneumatic Valves, Open and Close loop control system, Control of DC Motors,PermanentMagnetDCMotors,brakingofDCMotors,ACMotors,StepperMotorsandControls. **Sensors, transducers and application:** Performance Terminology, Static andDynamicCharacteristics,Displacement,PositionandProximitySensors,PotentiometerSensors,LVDT,Optical Encoders, HallEffectSensors. **Programmablelogiccontrollers:** Programmablelogiccontrollers(PLC)Structure,Input/OutputProcessing,principlesofoperation,PLC versus computer, selectingaPLC. **Casestudies:**Mechatronicapproachtodesign,BoatAutopilot,highspeedtiltingtrain,automaticcarparksystem,coincounter,enginemanagementsystem,autonomous mobilesystem,antilockbrakesystemcontrol,UsingPLC for extending and retracting a pneumatic piston and two pneumatic pistons indifferent combinations.	24

TextBooks:

- W.Bolton,“Mechatronics–ElectroniccontrolsystemsinMechanical&ElectricalEngineering”,PearsonEducationLtd., 2003.

- K.P.Ramachandran,G.K.Vijayaraghavan,M.S.Balasundaram,Mechatronics-IntegratedMechanicalElectronicSystems,Wiley;

ReferenceBooks:

- JojiP,PneumaticControls,Wiley.
- DanNecsulescu,Mechatronics,Pearson
- DavidgAlciatore,MichaelBHistand,"IntroductiontoMechatronics and measurementsystems",McGraw Hill Education.
- ASmaili,FMrad,"Mechatronics–IntegratedTechnologiesfor Intelligent Machines,OxfordHigherEducation.
- NitaigourPremchandMahalik, "Mechatronics Principles, Concepts & Application",TataMcGrawHillPublishing Co.Ltd., 2003.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3
CO7	PO1/PO2/PO12/PSO3

Open Elective

BMEO-0007:SIX SIGMA & APPLICATIONS

Objectives: *Study of this subject will enable the students to develop their mental horizon byenhancing their knowledge and skills which will embed organizational skill & it would be overallbeneficial for any organization. The main objective is to provide to the students its principles andproblems associates during implementation so that the students make a significant contribution to anorganizationby use itsapplications invarious areas.*

Credits: 04 **L-T-P:3-1-0**

Module No.	Contents	Teaching Hours
I	***Introduction:***Principlesofsix-sigma,Statisticalbasis,ToolsandTechniques,DMAICprinciple,6Sofsixsigma ,Customerrequirements,Eliminationof wastes anddefects, Evolution of six sigma quality approach, Practical approach to six sigmaquality, Basic steps involved in the application of six sigma, TQM and sixsigma,Qualityimprovement,Sixsigma andother qualityinitiatives. ***Project Management Applications***: Areas of six sigma and its approach, Six-sigmamanagement method, Integration of project management, Effectivemanagementofsix-sigmaprojectsanddisciplinedsix-sigmamethodinmanagingprojectsin organization. ***Process Control Charts***: X & R charts, p & C charts, Limits calculations;Importance&Applications.	25
II	***LeanManufacturing***:Concept,goals,components,toolsandtechniques,JIT, KANBANsystem, wastereduction. ***Organizational Structure of Six-sigma***: Gains made by the global six sigmastars,sixsigmaandIndianindustries,sixsigmaconceptofprocesscapability,OrganizationalStructure,Projectmethodology,QuadrupleConstraints ofprojectmanagement,Businesssystemsimprovement,Importanceofevaluating thesuccessofprojects,Importancecareerpathrequirements. ***Factories of future***: Nature and categories of FOF, Zero bases FOF, Designandplanningforfuturisticfactories.	25

TextBooks:

1. TheSixSigmaHandbook: AComplete GuideforGreenBelts,BlackBelts, andManagersat AllLevelsThomas PyzdekPaulA. Keller,Mc GrawHill.
2. Lean Six Sigma For Dummies, 2nd Edition Published by John Wiley & Sons, Ltd.,TheAtriumSouthern GateChichesterWestSussex PO19 8SQEngland.
3. THE LEAN SIX SIGMA BLACK BELT HANDBOOK Tools and Methods for ProcessAccelerationFrankVoehl •H.James HarringtonChuckMignosa•Rich Charron,CRCPress

ReferenceBooks:

1. Skimmar,Wickham, Manufacturing in the corporate Strategy, John Wiley and sons,NewYork
2. HearmBuckandButler, D.M.,Economic product Design, Colhins,London
3. Cluttarbuck,JIT–AGlobal StatusReport,IFSpublications
4. MichaelJ.Termini,Thenewmanufacturingengineer,Societyofmanufacture engineerMichigan,USA

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Attheendofthecoursethestudentwouldbeableto:

CO1: Explain complete range of topics starting from its basic idea to its applications in various areas.CO2: Describetools&techniques,eliminationofwastesandtheirreductioninpresent scenario.

CO3:Understandthathowtoanalysisthevariouscontrolchartsforprocessvariations.CO4: ExplaintheconceptofLean manufacturingandits widescope.

CO5:UnderstandtheBusinesssystemsimprovement,Importanceofevaluatingthesuccessofprojects.

CO6: Understand theconceptofFactoryoffuture,Zero basesFOF.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs / PSOs
CO1	PO1,PO2, PO3
CO2	PO2,PO3 / PSO1
CO3	PO2,PO3 / PSO1
CO4	PO1,PO2 / PSO2
CO5	PO1 / PSO1
CO6	PO1,PO3 / PSO1, PSO3

BMEE – 0900: PRODUCT DESIGN & DEVELOMENT

Prerequisites: *The knowledge of engineering drawing and to understand, ability to read technical drawing.*

Objectives: *To learn the sketcher workbench, part modeling and designing, wireframe and Surfacing for designing, assembly designing, &Drafting workbench.*

Credits: 04 L-T-P: 4:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	**Part Modeling -** Introductions to 3D Experience Software, File Management, Rotate, Zoom, Fit, Refresh, Delete, Undo, Redo Shaded View, Wire frame, Toolbar, sketching tool- line, profile, arc, centerline, Rectangle, Spline, Ellipse, Conics, Trim, Fillet, symmetry, Offset, Break, Create & Modify Dimension, Fix, Horizontal, Vertical, Parallel, Perpendicular, coincidence, symmetric, Tangent, Collinear, concentric. Pad, Pocket, Edge Fillet, variable Radius Fillet, Tritangent Fillet, Face-Face Fillet, Chamfer, Edit Parameter, Edit Sketch, Delete, Isolate, Multi Pocket, MultiPad, Shaft, Groove, Hole Creating Points, Reference Lines, Reference, Planes, Rib, Slot, Stiffener, Combined Solid, Multisection Solid, and Multisection cut Models, Draft Shell, Thickness, Thread, Mirror, Scaling, Translate Bodies, Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, and User Pattern.	25
II	**Wireframe &Surface Design -** Circle, Splines, Helix, Corner, Connect Curve, Projection, and Intersection .Extrude, Revolved, Spherical, Cylindrical, Offset, Fill, Swept, Loft, Blend, Join, Split, Trim, Healing, Untrim, Disassemble, Boundary, Extract, Split, Thick Surface, Closed Surface, Sew. **Assembly -** Snap, Smart Move, Constraining,Joints- Pin, Prismatic, Cylindrical. **Drafting:**Generations of views, Auxiliary View, Sections view, Detail view , Partial View, Brocken view, Create Dimension, Create note, Generating Layouts	25

Outcomes: *After studying these topics, the student will be able to*

- To give shape to the idea, concept design and controlling the geometrical shape of the designed component.
- To create 3D model of the design concept, understanding the part designing requirements that fulfil the design needs of various modules like CAE, CAM, CMM, Tool Designing, Drafting, 3D Printing.
- To understand, create, and control the complex shape geometries. To design & develop a new product from the existing one.
- To design assemblies, mechanism for validation.
- To understand the industrial drafting standards and generating industrial drawing.

Text Books:

- Catia v5 design fundamentals: a step by step guide by JaecheolKoh.

Reference Books:

- *CATIA V5-6R2015 Basics: Sketcher Workbench, Part Modeling, Assembly Design, Drafting, Sheet Metal Design, and Surface Design,Create Space Independent Publishing Platform (September 13, 2015)*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the basic commands of sketcher Workbench.
2. Understand and analysis the part modeling and designing in CATIA.
3. Describe the various methods to learn wireframe and Surfacing for designing.
4. Develop the various part of assembly design and learn the respective commands.
5. Describe the various methods to learn Drafting workbench.
6. Develop the various part of conceptual designing and learn the respective commands.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO6, PO7/ PSO1
CO3	PO1,PO7/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEE – 0901: PRODUCT DESIGN & MANUFACTURING

Prerequisites: *The knowledge of manufacturing & design processes. To understand, ability to read technical drawing and part modelling*

Objectives: *To learn parametric modelling, mechanism design & simulation, Sheetmetal Model Fundamentals, Creating Primary and secondary Sheetmetal Wall Features, Bending and Unbending Sheetmetal Models, Form features and modifying sheet metal models, the process of Sheetmetal Setup and Tools and Detail sheet metal design &Computer Aided Manufacturing*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Parametric Modeling:** Introduction to parametric modeling, declaring user defined parameter, integrating user defined parameters with designed model, applyingrelation with parameters, Defining the law using algebraic equations, Creating design table using current parameters, Importing the existing design table, Mirror, Scaling, Translate Bodies. Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, User Pattern. **Sheet metal Design:** Sheet metal Model Fundamentals, Creating Primary Sheet metal Wall Features, Creating Secondary Sheet metal Wall Features, Bending and Unbending Sheet Metal Models, Sheet metal Form Features, Modifying Sheet Metal Models, Sheet metal Setup and Tools, Detail sheet metal designs.	30
II	**Manufacturing:** Manufacturing Process Overview, Creating Manufacturing Models, Configuring Operations, Using Reference Models, Using Work Piece Models, Creating and Using NC Model Assemblies, Creating and Configuring a Work Center, Creating and Configuring Tools, Using Manufacturing Parameters. **NC Sequencing:** Creating Face Milling Sequences, Creating Volume Milling Sequences, Creating Profile Milling Sequences, Creating Straight Cut Surface Milling Sequences, Advanced Surface Milling Options, Creating Roughing and Re-roughing Sequences, Creating Finishing Sequences, Creating Hole making Sequences, Using the Process Manager, Creating and Post-Processing CL Data Files.	20

Outcomes: *After studying these topics, the student will be able to*

- To design components with user defined parameters, formulas and algebraic expressions
- To design mechanism for motion and interference analysis
- Demonstrate various press working operations for mass production of sheet metal parts
- This enables to understand the mechanism behind the effective designing and modifying of the models.
- Prepare working drawings and setup for economic production of sheet metal components
- It enables to understand various machining Processes and creating NC Sequences for turning.

Text Books:

- Advanced CATIA V5 Workbook: Knowledge ware , by Richard Cozzens
- Computer Numerical Control Programming Basics by Steve Krar Arthur Gill

Reference Books:

- Manufacturing Technology - Vol. 1 by PN Rao
- Manufacturing Technology - Vol. 2 by PN Rao

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the basic commands to learn the advance part modeling.
2. Analyze and understand the advance wire frame and surfacing
3. Develop the various to learn parametric modeling
4. Describe the various methods to learn Computer Aided Manufacturing (CAM)
5. Understand the basic commands to learn integrated design and Manufacturing
6. Understand the basic commands to learn CNC Programming and Machining

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEE – 0902 : INJECTION MOLD DESIGN - I

Prerequisites: *The knowledge of molding and casting parameters and nomenclatures.*

Objectives: *To learn the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters, validate the design of mold design setup, analyzing part design for best gate location and analysis of mold flow, the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Injection Mold Design:** Plastic part design requirements and guidelines, Introduction to plastics material, Introduction to thermoplastic molding processes, Plastic part design principles - design for manufacturing, Design for Assembly, Introduction to mold design, Types of molds based on construction, Molding Undercuts-Part Ejection, Mold Venting.	25
II	Design of Feed system, Mold Cooling, Types of molds based on runner system, Mold Shrinkage, Mold Metals. **Mold Design - Core, Cavity:** Basic Mold Process, Prepare design models for the mold process	25

Outcomes: *After studying these topics, the student will be able to*

- This enables the students to demonstrate mold making process as well as to work on different types of molds.
- Will be capable to design various injection molding set up components like core, cavity etc.
- Understanding & Interpreting results and molding parameters. Also Troubleshooting molding problems.
- This enables the students to demonstrate mold making process as well as to work on different types of molds
- Will be capable to design various injection molding set up components like core, cavity etc.

Text Books :

- Injection Mold Design Engineering 8/31/07 Edition, by David Kazmer, Hanser Publications
- Fundamentals of Plastic Mold Design – 24 Jul 2012,by S. K. Nayak (Author), P.C. Padhi (Author), Y. Hidayatullah (Author)
- CATIA V5R20 for Designers – 6 Jan 2010,by Prof. Sham Tickoo Purdue Univ. (Author)

Reference Books:

- *Injection Molds for Beginners, by Rainer Dangel, Hanser Publications, Cincinnati*
- *The Complete Technology Book On Plastic Extrusion, Molding and Mold Designs Paperback – 2006, By Niir Board Of Consultants And Engineers (Author)*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the plastic part design requirements, mold design and its various aspects
2. Analyze the procedure of mold design.
3. Understand the various parameters of mold design.
4. To validate and analyze the design of mold design setup.
5. To do analysis of part design for best gate location and analysis of mold flow.
6. Understand the white light 3D Scanning process for data processing analysis and modeling.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEE – 0903 : INJECTION MOLD DESIGN - II

Prerequisites: *The knowledge of molding and casting parameters and nomenclatures.*

Objectives: *To learn the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters, validate the design of mold design setup, analyzing part design for best gate location and analysis of mold flow, the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Design Model Analysis**: Mold Models, Shrinkage, Work pieces, Mold Volume Creation, Parting Lines, Skirt Surfaces, Parting Surface Creation, Splitting Mold Volumes, Mold Component Extraction, Mold Features Creation, Filling and Opening the Mold.	25
II	**Mold Analysis:** Introduction to Molded Part Analysis, Searching and specifying materials, Selecting Gate location, Analyzing part design for best gate location. Analyzing Molding window, Understanding Result advisor, Interpreting results and molding parameters, Troubleshooting molding problems.	25

Outcomes: *After studying these topics, the student will be able to*

- This enables the students to demonstrate mold making process as well as to work on different types of molds.
- Will be capable to design various injection molding set up components like core, cavity etc.
- Understanding & Interpreting results and molding parameters. Also Troubleshooting molding problems.
- This enables the students to demonstrate mold making process as well as to work on different types of molds
- Will be capable to design various injection molding set up components like core, cavity etc.

Text Books :

- Injection Mold Design Engineering 8/31/07 Edition, by David Kazmer, Hanser Publications
- Fundamentals of Plastic Mold Design – 24 Jul 2012,by S. K. Nayak (Author), P.C. Padhi (Author), Y. Hidayatullah (Author)
- CATIA V5R20 for Designers – 6 Jan 2010,by Prof. Sham Tickoo Purdue Univ. (Author)

Reference Books:

- *Injection Molds for Beginners, by Rainer Dangel, Hanser Publications, Cincinnati*
- *The Complete Technology Book On Plastic Extrusion, Molding and Mold Designs Paperback – 2006, By Niir Board Of Consultants And Engineers (Author)*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the plastic part design requirements, mold design and its various aspects
2. Analyze the procedure of mold design.
3. Understand the various parameters of mold design.
4. To validate and analyze the design of mold design setup.
5. To do analysis of part design for best gate location and analysis of mold flow.
6. Understand the white light 3D Scanning process for data processing analysis and modeling.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEE – 0904: PRESS TOOL DESIGN

Prerequisites: *The knowledge of certain forging and forming processes.*

Objectives: *To learn product analysis, Design of Blanking, Piercing, Progressive and compound dies & introduction to Press Tool, Die sets, Guidelines for Design of Press Tools.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Product Analysis**: Introduction to Simulate, Theoretical Foundations, Structural Mechanics. Simulation Models, Explore materials and material properties, Understand and use structural constraints, Understand and use structural loads, Meshing, Understand convergence, Run structural analyses, Explore results, Refining the Design, Analyze assemblies with Simulate, Shells, Idealizations, Thermal Analysis.	25
II	**Press Tool Design:** Introduction to Presses and Auxiliary components, Classification based on Power Source, Press Frame, Actuation of Slides, No. of Slides in action, Sheet metal forming process, Force requirement for Blanking and Piercing, Introduction to Press Tool, Die sets. Design of Blanking, Piercing, Progressive and compound dies, Guidelines for Design of Press Tools, Center of Pressure in Un-symmetrically Profiled Components, Analysis of Press Tool, Design of Bending, drawing and forming dies.	25

Outcomes: *After studying these topics, the student will be able to*

- Able to formulate type analyses for various different analysis or optimization objectives
- Illustrate the principles and blank development in bent & drawn components
- Identify press tool requirements to build concepts pertaining to design of press tools

Text Books :

- *Lal, Jagdish, "Hydraulic Machines", Metropolitan Book Co. Pvt. Ltd.*
- *Rajput, R K, "Hydraulic Machines", S. Chand & co Ltd.*
- *Kumar, D. S., "Hydraulic Machines", Khanna Publishers*

Reference Books:

- *Press Tools Design and Construction by P H JOSHI (SheetMeta*l)

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs:

1. To learn Sheet-metal model fundamentals, creating primary and secondary sheet-metal wall Features
2. To learn Bending and Unbending Sheet-metal Models, Form features and modifying sheet metal models.
3. To learn the process of Sheet-metal Setup and Tools and Detail sheet metal designs

4. Design of Blanking, Piercing, Progressive and compound dies.
5. Introduction to Press Tool, Die sets, Guidelines for Design of Press Tools
6. To learn rapid prototyping or additive manufacturing, RPT Data Processing, Data Post Processing, Solid based rapid manufacturing processes.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1, PO7, PO6
CO5	PO1, PO7/ PSO1
CO6	PO1,PO5/ PSO2

BMEE – 0905: PRESS TOOL MANUFACTURING

Prerequisites: *The knowledge of engineering press tool design, pressing tools, processes and machines*

Objectives: *To make the students understand the concepts of prototyping with manufacturing by giving more emphasis to their applications in engineering.*

Credits: 04 L-T-P: 4:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	**Rapid Proto typing**: Introduction to Rapid Prototyping, Design for modularity, Data Preparation, FDM manufacturing processes, RPT Data Processing, Data Post Processing, 3D Printing.	20
II	**Press Tool Manufacturing:** 300 Ton Press Deep Draw Press, Co2 Welding Machine, Spot Welding Machine, Press Tool Machining, Press Component Manufacturing, Assembly	20

Outcomes: *After studying these topics, the student will be able to*

- Understand Partial differentiation and its applications
- Trace the curves given in Cartesian coordinates
- Determine the linear dependence of functions
- Find the inverse of a square nonsingular matrix by various methods
- Solve the ordinary differential eqns. of higher order and grasp their applications

Text Books :

- Lal, Jagdish, “Hydraulic Machines”, Metropolitan Book Co. Pvt. Ltd.
- Rajput, R K, “Hydraulic Machines”, S. Chand & co Ltd.
- Kumar, D. S., “Hydraulic Machines”, Khanna Publishers

Reference Books:

- Press Tools Design and Construction by P H JOSHI (SheetMetal)

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

COs:

1. Understand and learn Sheet-metal model fundamentals, creating primary and secondary sheet-metal wall Features
2. Analyze and learn Bending and Unbending Sheet-metal Models, Form features and modifying sheet metal models.
3. Understand and learn the process of Sheet-metal Setup and Tools and Detail sheet metal designs
4. Student will able to design of Blanking, Piercing, Progressive and compound dies.
5. Introduction to Press Tool, Die sets, Guidelines for Design of Press Tools
6. Understand and learn to do rapid prototyping or additive manufacturing, RPT Data Processing, Data Post Processing, Solid based rapid manufacturing processes.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1, PO7, PO6
CO5	PO1, PO7/ PSO1
CO6	PO1,PO5/ PSO2

BMEE – 0906: SMART MANUFACTURING

Prerequisites: *The knowledge of basic electronic engineering components circuits and C language.*

Objectives: *To learn the concepts of IOT, identify the different technology, different applications in IOT, different applications in IOT, different protocols used in IOT & Predictive Maintenance.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Basics of IOT:** What is IOT? Network Architecture, Device Architecture, What is Embedded? **Basic Hardware in IOT:** Basic Electronics Components of IOT, LED, Resistors, Capacitors, Transistors, Relay, Switch, Buzzer, LDR, Potentiometer, PIR, How to glow LED without program, LED by switch, LED by two switch. **Controller use in IOT:** What is Arduino & ESP8266? History of Arduino & ESP8266, Hardware and Software Description, Fundamentals, Basic Arduino Programs, Serial Monitor and Debugging Tool, Installing Board Packages, Installing Sensor Libraries, Interfacing Sensors.	25
II	**Tinker cad Simulation:** Basic Electronic Circuits, Arduino Simulation. **Augmented reality**: Introduction to AR, The Basics of AR functionality, Taking the next steps with ARCore, Bringing ARCore to life, Frameworks of Software Development Tools in VR. **IOT Communication Protocols:** Wireless Protocols (SPI, I2C, UART, USRT), Networking Protocols (OSI Reference Model, TCP/IP, Ethernet), Sending data to Thingsboard.io/Adafruit. **Preventive Maintenance:** Maintenance Method Selection, Function and components, Failure Modes, Maintenance method and essential care tasks. **Thingworx Composer:** Introduction to Thingworx, Creating Thing, Thing Template, Building Mashups, Creating Weather mashup	25

Outcomes: *After studying these topics, the student will be able to*

- Understand Partial differentiation and its applications
- Trace the curves given in Cartesian coordinates
- Determine the linear dependence of functions
- Find the inverse of a square nonsingular matrix by various methods
- Solve the ordinary differential eqns. of higher order and grasp their applications

Text Books:

- The Internet of Things (MIT Press Essential Knowledge series) ,by Samuel Greengard (Author)
- IOT (Internet of Things) Programming: A Simple and Fast Way of Learning IOT ,by David Etter (Author)

Reference Books:

- Arduino for Beginners: Step-by-Step Guide to Arduino, by Author Simon Knight
- Beginning c for Arduino, by Jack Purdam
- Things Worx third edition, by Gerardus Blokduk

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. To learn the concepts of IOT and its application in Manufacturing Industry.
2. To learn different protocols used in IOT.
3. To learn about different sensors and its data collection in IoT platform.
4. To learn about different controllers in IoT and its use.
5. To learn ThingWorx IIoT platform and use it with real-time projects.
6. To learn about Predictive maintenance & asset monitoring using IoT.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1, PO7, PO6
CO5	PO1, PO7/ PSO1
CO6	PO1,PO5/ PSO2

COURSE STRUCTURE

B.TECH.

MECHANICAL ENGINEERING

(SPECIALIZATION IN AUTOMOBILE ENGINEERING)

Under

Choice Based Credit System (CBCS)

S.No.	Department	Program Offered	Credits		Total Credits
1	ME	B.Tech. Mechanical Engineering (Specialization in Automobile Engineering)	HSS	25	184
			BS	24	
			ES	28	
			PC	48	
			PE	26	
			OE	16	
			Proj	17	
			MNG	8 U	

First Year

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT HR/WK
			L	T	P		
1	BMEG0001	Basic of Mechanical Engineering	3	1	0	0	4
2	BMEG0002	Applied Mechanics	3	1	0	0	4
		PRACTICALS					
3	BMEG0802	Applied Mechanics Lab	0	0	2	0	1
4	BMEG0800	Engineering Workshop Lab	0	0	2	0	1
5	BMEG0801	Engineering Drawing	0	0	2	0	1
6	BMEG0803	CAD Lab	0	0	2	0	1

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
		THEORY							
1	BME C0002	Applied Thermodynamics	3	1	0	0	4	4	Basic Mechanical
2	BME C0005	Fluid Mechanics	3	0	0	0	3	3	Engineering
3	BME C0007	Strength of Material	3	0	0	0	3	3	Applied Mechanics
4	BMEC 0008	Kinematics of Machines	3	0	0	0	3	3	Applied Mechanics
5	BMEC 0009	Dynamics of Machine	3	0	0	0	3	3	Kinematics of Machines
6	BME C0010	Machine Design I	3	0	0	0	3	3	Strength of Material
7	BME C0014	Modern Vehicle Technology	3	0	0	0	3	3	
8	BMEC 0016	Fuels and Lubricants	3	0	0	0	3	3	

9	BMEC 0017	Automotive Petrol and Diesel Engines	3	0	0	0	3	3	Thermodynamics
10	BMEC 0018	Automotive Electrical and Electronics System	3	0	0	0	3	3	Kinematics of Machines, Elements of Electronic Engineering
11	BMEC 0019	Vehicle Body and Dynamics	3	0	0	0	3	3	
12	BMEC 0020	Automotive Chassis and Transmission System	3	0	0	0	3	3	
13	BMEC 0021	Automotive Engg.	3	0	0	0	3	3	Kinematics of Machines, Dynamics of Machines
14	BMEC 0022	Two and Three Wheeler	3	0	0	0	3	3	Automobile System
PRACTICALS									
15	BME C0803	Fluid Mechanics Lab	0	0	2	0	1	2	BME C0005
16	BMEC 0805	Theory of Machine Lab	0	0	2	0	1	2	BMEC 0009
17	BME C0806	Machine Design I Lab	0	0	2	0	1	2	BME C0010
18	BMEC 0810	Automotive Electrical and Electronics System Lab	0	0	2	0	1	2	BMEC 0018
19	BMEC 0811	Automotive Engg. Lab	0	0	2	0	1	2	BMEC 0021
Total			**42**	**1**	**10**	**0**	**48**	**53**	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet:Thermal Automotive									
THEORY									
1.		Vehicle Performance & Testing	3	0	0	0	3	3	
2.		New Generation and Hybrid Vehicles	3	0	0	0	3	3	
3.		Trouble Shooting, Servicing And Maintenance Of Automobiles	3	0	0	0	3	3	
4.		Automobile Air Conditioning	3	0	0	0	3	3	Thermodynamics
5.	BMEE0006	Gas Turbine and Jet Propulsion	3	1	0	0	4	4	Applied Thermodynamics
6.	BMEE 0008	Solar Energy	3	0	0	0	3	3	Applied Thermodynamics
PRACTICALS									
7.	BMEE 0172	Solar Energy Lab	0	0	2	0	1	2	BMEE 0008
8.	BMEE 0186	Project based Solar Energy Lab	0	0	0	8	2	8	BMEE 0008

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Fluids Automotive									
THEORY									
9.		Alternative Fuels And Pollution control	3	0	0	0	3	3	Chemistry
10.	BMEE0101	Advanced Fluid Mechanics	3	1	0	0	4	4	Fluid Mechanics
11.		Automotive Aerodynamics	3	0	0	0	3	3	
12.	BMEE0105	Computational Fluid Dynamics	3	0	0	0	4	4	Numerical Methods & Turbulent Flow
PRACTICALS									
13.	BMEE0175	CFD Lab	0	0	2	0	1	2	BMEE0105

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet:Design & Safety of Automotive									
THEORY									
14.	BMEE0203	Finite Element Methods	3	1	0	0	4	4	Continuum Mechanics
15.	BMEE0204	Vibration and Noise	3	1	0	0	4	4	Dynamics of Machine
16.		Off-road Vehicles	3	0	0	0	3	3	Machine Design
17.		Design of Transmission Systems	3	0	0	0	3	3	
18.		Automotive Safety	3	0	0	0	3	3	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
Bouquet: MANUFACTURING (MFG)									
THEORY									
1.	BMEG0900	Product Design & Development	5	0	0	0	5	5	
2.	BMEG0901	Product Design & Manufacturing	5	0	0	0	5	5	
3.	BMEE0900	Product Design & Development	4	0	0	0	4	4	
4.	BMEE0901	Product Design & Manufacturing	4	0	0	0	4	4	
5.	BMEE0902	Injection Mold Design - 1	4	0	0	0	4	4	
6.	BMEE0903	Injection Mold Design - 2	4	0	0	0	4	4	
7.	BMEE0904	Press Tool Design	4	0	0	0	4	4	
8.	BMEE0905	Press Tool Manufacturing	4	0	0	0	4	4	
9.	BMEE0906	Smart Manufacturing	4	0	0	0	4	4	

Projects (J)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
1.	BEEJ0950	Mini Projects - I	0	0	0	4	1	4	
2.	BEEJ0951	Mini Project - II	0	0	0	12	3	12	
3.	BEEJ0953	Minor Project	0	0	0	12	3	12	
4.	BEEJ0955	Major Project	0	0	0	32	8	0	
5.	BEEJ0991	Industrial Training	0	0	4	0	2	0	
		TOTAL	**0**	**0**	**0**	**60**	**17**		

Mandatory Non Graded Course (M)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
		TOTAL	**8**	**0**	**0**	**0**	**0**	**8**	

Humanities and Social Sciences (H)

S. NO.	CODE	SUBJECT	TEACHING SCHEME L	T	P	J	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purpose – I	2	0	0	0	2	2	
4.	BELH 0004	English for Professional Purpose – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAC0005	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH 0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	4	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	4	
TOTAL			**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences (S)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences (G)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG1001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic of Mechanical Engineering	3	1	0	0	4	4	
4.	BEEG0002	Electrical Technology	3	0	0	0	3	3	
5.	BCSC0001	Computer Programming	4	1	0	0	5	5	
PRACTICALS									
6.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
	BEEG0801	Electrical Simulation Lab	0	0	4	0	2	4	
7.	BEEG0802	Electrical technology Lab	0	0	2	0	1	2	
8.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
9.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
10.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
11.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
TOTAL			16	4	14	0	28	16	

Open Elective (Offer to other Departments)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEO0090	Electrical Machine & Automatic Control	3	0	0	0	3	3	
2.	BEEO0092	Non-Conventional Energy Resources	4	0	0	0	4	4	
PRACTICALS									
3.	BEEO0900	Electrical Machines & Automatic Control Lab	0	0	2	0	1	2	BEEO0090

BME G 0001: BASIC MECHANICAL ENGINEERING

Objective: *Precise thermodynamics education is a requirement to discuss issues that one faces in thermodynamics and resulting studies in global warming, energy conversion and other energy related topics that affect sustainability of the environment in the global sense. Also introduce the students to various basic manufacturing processes carried out in various industries very commonly.*

Credits: 04

Semester I/II **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Fundamentals of Thermal Engineering:** Thermodynamic systems, State & properties, Thermodynamic equilibrium & processes, Heat & work, Work done for different polytrophic processes, Zeroth law of thermodynamics and its applications, First law of thermodynamics, Steady flow energy equation, Application of first law to various thermodynamic systems and its limitations. **Second Law of Thermodynamics:** Concept of heat engine, heat pump & refrigerator, Second Law of Thermodynamics, Carnot Cycle, Carnot theorem.	20
II	**Concept of Entropy:** Clausius Inequality, Concept of entropy, Entropy change during various processes. **Steam & its Properties:** Definition of pure substance, Phase change, p-T diagram and pV-T surfaces, Formation of Steam, Concept and determination of dryness fraction of steam, Thermodynamic properties of steam, Steam table and Mollier diagram. **Introduction to Manufacturing Processes**: Mechanical properties of materials, Engineering Materials: Plain carbon steel and its applications **Casting Process:** Patterns and types of patterns and their allowances, Moulding sand and its properties, Elements of gating system**.** **Fabrication processes:** Introduction and classification of welding, principle and applications of Shielded Metal Arc Welding and Gas Welding.	20

Text Books:

- Yadav R.: "*Thermodynamics and Heat Engines*" :Vol I & II (Sl Edition) Central Publishing House Allahabad,2010.
- Kumar D.S: "Thermal Science and Engineering" :S.K Kataria and Sons,Delhi,2004.

Reference Books:

- Nag P. K.: "*Engineering Thermodynamics*": TMH,2017.
- Yadav R.: "*Thermodynamics and Heat Engines*" : Vol I & II (Sl Edition) Central Publishing House Allahabad,2010.
- HajraChowdhary SK and HajraChowdhary AK. "*Workshop Technology*": Media Promotors & Publishers,2010.
- Raghuwanshi RS, "*Workshop Technology*": Dhanpat Rai and Sons, New Delhi,2012.
- WarkWenneth: "*Thermodynamics*":McGraw Hill book Co.NY,2015.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *At the end of the course the student will be able to:*

- *CO1: Understand the basic laws of thermodynamics and their applications in realworld.*
- *CO2: Calculate heat and energy transfer occur in atmosphere and in components under thermal engineeringapplications.*
- *CO3: Interpret the behavior of steam and its applications in thermalengineering.*
- *CO4: Acknowledge the application of thermal engineering associated with humanbody.*
- *CO5: Understandthe basic industrial processes of metal joining, fabrication & casting with applications in realworld.*
- *CO6: Develop basic know how and awareness of various manufacturingprocesses.*

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO6, PO7/ PSO1
CO3	PO1,PO7/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BME G0002 APPLIED MECHANICS

Objective: *The aim of the applied mechanics is to teach the basic analytical methods that is the fundamental concepts and techniques of engineering mechanics.*

- *To give students practice in applying their knowledge of mathematics, science, and engineering and to expand this knowledge into the vast area of Applied Mechanics.*
- *Toenhancestudents'abilitytodesignbyrequiringthesolutionofopenendedproblems.*
- *TopreparethestudentsforhigherlevelcoursessuchascoursesinMechanicsofSolids,MechanicalDesign and Structural Analysis.*

Credits: 04 **Semester I/II** **L–T–P:3–1–0**

Module No.	**Content**	**Teaching Hours**
I	**Introduction: -** Mechanics: Idealization of Bodies, concept of Rigid Bodies, External Forces, Moment and Couple, Laws of Mechanics. **Force Systems And Equilibrium: -** Fundamental Concepts and principles of Mechanics. Reduction of a system of forces to a force couple system**,** Concurrent forces in a plane, Free Body Diagrams, Equations of equilibrium and their applications to various systems of forces. **Friction: - Friction forces and laws of dry friction,** Types of friction and their applications to ladder and belt-pulleysystems **Distributed Forces and Moment Of Inertia:-**Basic concepts of Centroid, Area MomentofInertia,PolarMomentofInertia,Productofinertia,Principalaxes, Parallelaxistheorem,Perpendicularaxistheoremandtheirapplicationsin Composite figures.	22
II	**Beams: -** Introduction of a Beam and its types**,** Concept of bending moment and shear forces in beams, Shear Force and Bending Moment Diagrams for differentloadingconditions(pointload,uniformlydistributedload,uniformly varying load andcouple). **Analysis of Plane Trusses: -** Engineering structures, Perfect Truss, Determination of axial forces in the members, Method of Joints, Method of Sections. **Kinematics and Kinetics of Rigid Bodies: -** Plain motion of rigid bodies, Velocity and acceleration under translation and rotation, Work, Power and Energy, Impulse and Momentum, D' Alembert's Principle and Law of conservation of energy.	23

Text Books:

- Tayal,A.K.EngineeringMechanics:Statics&Dynamics,14thEdition(2011),UmeshPublications,Delhi
- V.S.Mokashi,EngineeringMechanics:StaticsVol.I&DynamicsVol-II,(TataMcGraw-Hill),NewDelhi

Reference Books:

- Shames, I.H (1996), Engineering Mechanics, Statics and Dynamics 4th edition, Prentice Hall of India Pvt. Ltd., New Delhi (EEE)
- F.P. Beer & E.R. Johns ton et.al., Vector Mechanics for Engineers: Staticsand Dynamics, 12th Edition (2019) TMH New Delhi

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *At the end of the course the student will be able to:*

- *Understand the representation and analysis of forces, moments, and equilibrium of particles and rigid bodies, Concept and principles of work and energy.*
- *The effect of friction and its role in engineering applications.*
- *Develop basic knowhowandawarenesstodealwithreallifeapplicationsinvariousfieldsofengineering.*
- *Determine internal actions in statically determinate structures and draw internal action diagrams –Shear Force (SFD) and Bending Moment Diagrams (BMD) for these structures.*
- *Identifyanappropriatestructuralsystemtostudyagivenproblemandisolateitfromitsenvironment*
- *Developconceptsofrigidbodykinematicsanddynamicswithanemphasisonthemodeling, analysis, and simulation of how forces produce motion of rigid body systems.*

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2/ PSO1
CO3	PO1, PO2/ PSO1
CO4	PO1, PO2/ PSO1
CO5	PO1, PO2/ PSO1
CO6	PO1, PO2/ PSO1
CO7	PO1, PO2/ PSO1
CO8	PO1, PO2/ PSO1

BME G0800: ENGINEERING WORKSHOP PRACTICE LAB

Objective: *The purpose of this lab is to enable the students to have the practical skills for basic manufacturing processes and to study the various tools & equipment used e.g. Machining, Surface finishing, Welding, Casting, Drawings (Developments), Measuring instruments. The student will also have practical exposure with various safety precautions in different sections of the shops.*

Credits: 01 **L–T–P-J:0–0–2-**

Module No.	Content	Lab Hours
I	**List of Experiments** **Machine Shop:** **(1)** To study the working of basic machine tools like Lathe m/c, and Drilling m/c. **(2)** To perform the following operations on Centre Lathe: **(i)** Centering, Facing, Turning, Step turning, Taper turning. **(ii)** Knurling, Grooving, Chamfering, and Threading. **Welding Shop:** **(1)** To prepare Lap joint, Butt joint, T-joint by using an Electric Arc welding. **(2)** To prepare Lap joint, Butt joint, T-joint by using an Oxy-Acetylene gas welding. **Carpentry Shop:** **(1)** To perform different operations in Carpentry shop such as cutting, planning and chiseling on the given wooden piece. **(2)** To prepare a joint Lap joint, T-Joint, Dovetail joint by using wooden specimen/piece. **Foundry Shop:** **(1)** To prepare a Sand mould for solid casting with the help single piece pattern & split pattern. **(2)** To prepare the mould for hollow casting with the help of pattern andcore. **Sheet Metal Shop:** **(1)** To develop the blank dimensions for the given product using development process. **(2)** To prepare a Funnel of required dimensions using joining processes. **Fitting Shop:** **(1)** To perform the operations of Marking, Filing and Sawing on the given	30

	metallic work-piece (M.S.) as per givendimensions. **(2)** To perform the operations of drilling of making the holes on the given metallic work-piece (M.S.) by use of Drillingmachine. **(3)** To perform the operations of making internal threads by use of tapes and dies.	

Text/Reference Books:

- *John K. C., "Mechanical Workshop Practice": PHI Learning Pvt. Ltd., New Delhi,2010.*
- *ChoudharyHajra, "Elements of Workshop Technology": Media Promoters & Publishers Pvt. Ltd., Mumbai,2010*
- *ChapmanW.A.J., "Workshop Technology", CBS Publishers & Distributors, New Delhi,2007*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *On successful completion of this lab, the students will be able to:*

CO1: Demonstrate an understanding of and comply with workshop safety regulations.

CO2: Select and perform a range of machining operations like: turning, facing, knurling drilling, grinding etc. to produce a given job.

CO3: Acquire basic knowledge of welding, joint design such as Lap joint, Lap T-joint, Edge joint, Butt joint and Corner joint and the application ofwelding.

CO4: Abilityto designandmodeldifferentprototypesinthecarpentrytradesuchasCrosslapjoint,Dove tailjoint.

CO5: Ability to design and model various basic prototypes in the trade of fitting such as Straight fit, V- fit.

CO6: Ability to make various basic prototypes in the trade of Tin smithy such as rectangular tray, and open Cylinder.

CO7: Student will able to design mould with the help of green sandmould.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Outcomes (PSOs):

Cos	**POs/PSOs**
CO1	PO1
CO2	PO1, PO3/PSO1
CO3	PO1, PO3/PSO1
CO4	PO3/PSO1
CO5	PO3/PSO1
CO6	PO3/PSO1
CO7	PO3/PSO1

BME G0802: APPLIEDMECHANICS LAB

Objective: *This course introduces the fundamentals of statics in engineering, which are prerequisites for further study of advanced mechanics. The main objective of the course is to learn basic principles of static in mechanics analyses, such as rigid bodies, friction between two surfaces, centroid, reaction of beam, Newton's laws of motion and analysis of truss. It also includes a range of essential steps for solving problems in statics.*

Credits: 01 **Semester: I/II** **L–T –P:0–0–2**

Module No.	Content	Teaching Hours
1	**List of Experiments:** **1.** Study of functioning of gear trains. **2.** To find the mechanical advantages, velocity ratio and efficiency of worm and worm wheel. **3.** To find the coefficient of friction between the surface ofa given wood slide bar and an inclined plane. **4.** To find centre of gravity of different geometrical objects. **5.** Deflection of simply supported beam and verification of theoretical values. **6.** To find reaction at the supports of a simply supported beam with different types of loading. **7.** To determine the modulus of rigidity of rod with the help of torsion testing machine. **8.** To study functioning of belt pulley systems. **9.** To find moment of inertia of a fly wheel about the axis of rotation using electronic counter machine. **10.** To find forces in members of a truss for different load conditions.	24

Outcome: At the end of the course the student will be able

- ✓ *To know the practical skills to analyze the forces, moments, and their equilibrium.*
- ✓ *To know the practical skills to analyze the effect of friction.*
- ✓ *To develop basic, knowhow and awareness to deal with practical aspects of applied mechanics.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1, PO2/ PSO1
CO3	PO1, PO2/ PSO1

BMEG 0801 ENGINEERIN GDRAWING

Objective: *Technical drawing is the language of engineering. The objective of this course is to learn initially the basic principles involved in the projection of points, lines, lamina and solids. As well this course is focused towards the interpenetration of solids, development of surfaces, isometric drawings and some basics of computer aided drafting software. It is expected that a student should learn this subject in a very systematic way to develop the skill to express effectively his/her idea about an object to others through drawings.*

Credits: 01 **L–T–P-J: 0–0–2-**

Module No.	Content	Teaching Hours
I	**Introduction** Drawing instruments and their uses, BIS conventions, lettering dimensioning and free hand practicing (2 Drawing sheets) **Geometric construction & engineering Scales** Basic geometric construction -Dividing a given straight line into any number of equal parts, drawing a regular polygon given one side, conic sections – ellipse – parabola. Concepts of scales –Plain, Diagonal & scale of chord. (2 Drawing sheets) **Orthographic projection** Introduction to projection &orthographic Projections *Projections of points* lying in four quadrants *Projection of lines*- parallel and inclined to one or both planes *Projection of planes*- inclined to one or both planes. *Projections of solids* - axis perpendicular to HP, axis perpendicular to VP and axis inclined to one or both planes. (4 Drawing sheets) **Sectioning of solids-** Section planes perpendicular to one plane and parallel or inclined toother plane. (1Drawing sheets) **Development of surfaces-** Development of prisms, pyramids and cylindrical & conical surfaces (1Drawingsheets) **Isometric projection -**Isometric projection and isometric views of different planes and simple solids (1Drawing sheets) **Computer aided drafting** Introduction to computer aided drafting **(4)** Package to make 2-D drawings.	24

Text Books:

- Venugopal, K. and Prabhu Raja, V.: 'Engineering Drawing and Graphics + AutoCAD': New Age International,2017.
- Agrawal &Agrawal ,C.: 'Engineering Drawing' : Tata McGrawHill,2014.

Reference Books:

- Bhatt, N. D. and Panchal, V.M., 'Engineering Drawing': Charotar PublishingHouse,2010.
- Natarajan, K. V., 'A text book of Engineering Graphics': Dhanalakshmi Publishers,Chennai,2014.
- Venugopal, K. and Prabhu Raja, V., 'Engineering Drawing and Graphics + AutoCAD': New Age International,2017.
- Jolhe, D. A., 'Engineering drawing':Tata McGrawHill,2010.
- TrymbakaMurthy,S.,'ComputerAidedEngineeringDrawing':I.K.InternationalPublishingHouse, 2008.
- Agrawal &Agrawal ,C., 'Engineering Drawing':Tata McGrawHill,2014.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcomes: *At the end of the course the student will be able to*

CO1: Know and understand the conventions and the methods of engineering drawing.
CO2: Interpret engineering drawings using fundamental technical mathematics.
CO3: Improve their visualization skills so that they can apply these skills in developing new products.
CO4: Improve their technical communication skill in the form of communicative drawings.
CO5: Comprehend the theory of projection, Interpret views and sectional views and projections.

COs	POs/ PSOs
CO1	PO1/ PSO1
CO2	PO1/ PSO1
CO3	PO3/ PSO1
CO4	PO10/ PSO1
CO5	PO3/ PSO1

BME G0803 COMPUTER AIDED, DRAFTING LAB

Objective: *The objective of this course is to teach users the basic commands and tools necessary for professional 2D drawing, design and drafting using AutoCAD.*

Credits: 01 **Semester I/II** **L–T–P:0–0–2**

Module No.	Content	Teaching Hours
I	**Getting Start –** Starting with autocad, open and save files, tool bars, screen layouts. **Basic Drawing & Editing Commands-** Drawing Lines, rectangles, Circles, viewing Drawing, Undo & Redo commands, Erasing objects etc. **Drawing Precision-** Using Object snap, O snap overrides, Polar tracking settings, Drawing with SNAP & GRID, function keys. **Changes in Drawings-** Selecting object for editing, Moving objects, copying, Rotating object, Scaling, mirroring editing with Grips. **Drawing Organization & Information Layers** Templates, Layers, Layer State, changing object layers, etc. **Advance Editing Commands-** Trimming & extending, Stretching, Creating Fillets and Chamfers, Offset, creating arrays of objects. **Blocks** Insertion of Block from tool Palettes, using insert, with design centre. **Annotation-** Text, Hatching, Dimensions **3 D Modeling-** Introduction, basic tools, 3D navigation tools, UCS. Formation of simple solids, solid primitives, mesh model. **Creating solid** from 2D – Extrude, Swept, revolve solid, lofted solid. **Editing Solid**- Editing faces of solid, Fillet and chamfer on solids 2d view from 3d. Multiple viewports	24

Text Books:-

- Trymbaka Murthy, S., 'Computer Aided Engineering Drawing', Pub- I.K. International Publishing House.
- Venugopal, K. and Prabhu Raja, V., 'Engineering Drawing and Graphics + AutoCAD', Pub- New

Age International

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: After completing this course, the student will be able to:

CO 1: Use AutoCAD for daily processes requiring designing and drafting.
CO 2: Navigate throughout AutoCAD using major navigating tools.
CO 3: Understand the concept and techniques to draw typical geometries.
CO 4: Create multiple designs using several tools.
CO 5: Create layers to control the objects' visibility.
CO 6: Explain drawing using annotations.

Mapping of Course Outcomes (Cos) with Programme Outcomes(Pos) and Programme Specific Outcomes(PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO9/ PSO1
CO2	PO3, PO4, PO5/ PSO3
CO3	PO1, PO2, PO3/ PSO3
CO4	PO1, PO2, PO5/PSO1
CO5	PO1, PO3, PO10/ PSO3
CO6	PO1, PO5, PO10/PSO3

BME C0014: MODERN VEHICLE TECHNOLOGY

Objective: *The course content should be taught and curriculum should be implemented with the aim to develop different types of skills leading to the achievement of the following competency:*

- ***Improve efficiency, security, safety & performance of automobile using electronics and technology.***

Credits: 04 **Semester III** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Applications of Transducers & Sensors:** Concept of general measurement system & difference between Mechanical and electrical/ electronic instruments; Measurement of Temperature: Working of Thermocouple and Thermister; Measurement of Speed: Contact less electrical tachometer, Inductive, Capacitive type tachometer, Stroboscope; Measurement of Force: Strain gauge load cell; Basic requirement of Sensors, Functions, Applications and Circuitry arrangement of various Sensors such as Mass Air flow rate sensor, Exhaust gas Oxygen concentration, Throttle plate angular position, Crankshaft angular position, Coolant temperature, Intake air temperature, Manifold absolute pressure (MAP), Vehicle speed Sensor, Rain Sensor & Rain sensing wiper. **Advance Ignition system:** Electrical & electronics ignition system. Modern Spark Ignition system (e.g. D.T.S.I , T.D.S.I., Multi electrode etc. System) Insulated coils. Concept of Non-battery Energy Storage: Ultra capacitors and Flywheels. **Advancement in Engine and related components:** Introduction & types of hybrid vehicle. Hybrid drives systems. Compressed air car. Solar Cars. Hydrogen operated Engine. Basic concepts of Blue Motion Technologies like DSG, TSI, TDI, GDI variable valve timing system.	28
II	**Modernization in Peripheral systems:** Security Systems. Remote keyless entry, Anti-theft system, Alarm system. Entertainment and peripheral systems. Integrated communications, Proximity sensors, Global positioning satellites (GPS). **Advance Safety Equipments:** Seat Belts, Seat Belts pre-tensioners, Smart seatbelt Reminder, Concepts of Crash test, Crash sensors. Air bags Introduction of air bags, Duel stage air bags, Side Airbags. Tire pressure monitoring system Pedestrian Protection & Night vision with pedestrian detection. **Modern Features in Automobile:** Power Sliding doors. Electronic stability / Skid-control system, Traction control system. Telescopic steering wheel / adjustable pedals. Rear mounted Radar & Cameras.	21

	Electromagnetic suspension and levitation. Automatic Lift Axle. Regenerative Braking Systems. Continuous Variable Transmission. Intelligent Parking Assist System, Self Parking.	

Text Books:

- Tom Denton, 'Automobile Electrical and electronic systems', Arnold ISBN-0750662190, third edition, 2004.
- Thareja BL, 'Fundamentals of Electrical and Electronics Engineering', Nirja Construction & Development Co Ltd, New Delhi, 1984.
- P L Kohli , 'Automotive Electrical Equipments', Tata Mc- Graw Hill, New Delhi, 1983.
- A. K. Sawhney and PuneetSawhney, 'A Course in Electrical and Electronic Measurements and Instrumentation', Dhanpat Rai and sons, New Delhi, 1973.

Reference Books:

- John Turner, 'Automotive Sensors', Momentum press, LLC NEW YORK ISBN- 9781606500095 ,ISBN-1606500090, 2009.
- Barbara J. Peters, George A. Peters, 'Automotive Vehicle Safety', SAE International and Taylor & Francis ISBN - 978-0-7680-1096-1, London, 2002.
- J. Marek, H.-P. Trah Sensors, 'Automotive Technology', Y.Suzuki, I. Yokomor / ISBN – 3527295534 Wiley-vch ,weinheim, 2003.
- Jeff Daniels, 'Modern Car Technology', J Haynes & Co. Ltd., 2009

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: ***At the end of the course, a student will be able to***

CO1. Describe construction, functions and applications of various sensors and actuators used in modern vehicle. ***(Understand)***

CO2. *Explain modern Ignition systems of S.I. and C.I. Engines.* ***(Understand)***

CO3 Describe latest advancement in Engine technology. ***(Understand)***

CO4 Identify and describe various advanced peripheral system used in automobile. ***(Analyze)***

CO5 Demonstrate various safety features and equipment used in modern vehicle. ***(Apply)***

CO6 Describe various modern features like EBD, ABS, Regenerative Braking System etc for better functioning of vehicle. ***(Understand)***

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	POs/PSOs
CO1	PO1, PO3, PO6, PO12/ PSO1
CO2	PO1, PO3, PO4, PO6, PO10/ PSO1
CO3	PO2, PO3, PO4, PO6/ PSO1
CO4	PO2, PO3, PO4, PO6/ PSO1
CO5	PO3, PO6, PO9/ PSO1
CO6	PO1, PO3, PO6, PO9/ PSO1

BMEC 0016 FUEL AND LUBRICANTS

Credits: 03 **Semester IV** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Fuels:** Fuels and its types Chemical structure of petroleum, petroleum refining process, products of refining process, Important qualities of S.I and CI engine fuels, Rating of SI and CI engine fuels. **Properties & Testing of Fuels:** Calorific value of fuels and its determination, bomb calorimeter, propertiesand testing of fuels & Lubricants, viscosity and viscosity index, flash and fire point, cloud and pour point, oiliness steam emulsion number volatility, corrosion stability, carbon residue, aniline point, decomposition stability, precipitation number, ash content, neutralization number, specific gravity and API gravity, saponification number, iodine value, mechanical stability. Consistency and drop point test for grease. B.I.S specification for diesel, petrol, biodiesel and C.N.G. **Combustion:** Combustion in Spark Ignition Engines, stages of combustion in SI Engines flame front propagation, factors influencing the flame speed, rate of pressure rise, abnormal combustion, the phenomenon of knock in SI Engines, effect of engine variables on knock, Combustion in Compression Ignition Engines, stages of combustion in CI Engines, Factors affecting the delay period, The phenomenon of knock in CI Engines.	26
II	**Alternate Fuels:** Introduction, possible alternatives Solid fuels, Liquid Fuels, surface Ignition alcohol CI Engine, Spark assisted Diesel, Gaseous Fuels (Hydrogen, CNG, LPG) Duel fuel operation. Other possible fuels (Biogas, producer gas, Blast furnace gas, Coke oven gas, Benzol, Acetone, Diethyl ether, vegetable oil, biodiesel).Introduction to alternate energy source vehicles like, electric vehicle, hybrid, fuel cell & solar cars. **Lubricants:** Introduction, Friction, Specific requirements for automotive lubricants, functions of lubrication, Classification of lubricants (lubricating oils, semi solid lubricants or greases, solid lubricants, lubricating Emulsions). Synthetic lubricants. **Theory of Lubrication:** Mechanism of lubrication (Boundary lubrication, Elasto hydrodynamic lubrication, Hydrodynamic lubrication hydrostatic lubrication Extreme pressure Lubrication).Lubrication of Engine and Machine Components.	23

Text Book:

- Internal Combustion Engines by Ganesan V, Tata McGraw Hill Education Private Limited New Delhi.
- Lubrication, Raymond G. Gunther, Chipton Book Co.- 1971.
- Surface Engineering And Engineering Tribology by Dr R.B. Choudhary and M.K. Sharma R.Chand and Company
- Fuels – Solids, Liquids, Gaseous by Brame, J.S.S. and King, J.G.
- Fuels and Fuel Technology by Francis, W, Vol. I & II
- Modern Petroleum Technology by Hobson, G.D. & Pohl. W
- Lubrication–A practical guide to lubricant selection by A.R. Lansdown, Pergamon press – 1982.
- Energy today & tomorrow by MaheswarDayal, I & B Horishr India.
- Internal Combustion Engineering and Air Pollution by Obert. E.F., International Book Co., 1988.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: ***At the end of the course, a student will be able to***

CO1. Understand the manufacturing process of fuel and lubricants. ***(Understand)***

CO2. *Explain various B.I.S specifications of diesel, biodiesel, Bio-gas & CNG fuels.* ***(Understand)***

CO3 Understand fuel rating, additives to be used for grading the fuel, it's quality to increase or decrease for increasing the efficiency of the engine, according to climatic conditions. ***(Understand)***

CO4 Identify and distinguish clearly the properties of various alternate fuels & their application for clean environment & pollution control. ***(Analyze)***

CO5 Explain various properties of Lubricants & their applications. ***(Understand)***

CO6 Describe the mechanism of lubricants like Boundary Lubrication, Hydrodynamic lubrication etc. ***(Understand)***

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	POs/PSOs
CO1	PO1, PO3, PO6, PO12/ PSO1
CO2	PO1, PO3, PO4, PO6, PO10/ PSO1
CO3	PO2, PO3, PO4, PO6/ PSO1
CO4	PO2, PO3, PO4, PO6/ PSO1
CO5	PO1, PO3, PO6, PO10/ PSO1
CO6	PO1, PO3, PO6, PO9/ PSO1

BMEC 0017: AUTOMOTIVE PETROL & DIESEL ENGINE

Prerequisites: Thermodynamics, Basic Mechanical engineering
Objectives: *The purpose of this course is to impart adequate knowledge on SI Engines.*

Credits: 03 **Semester: V** **L–T–P: 3-0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Engine Construction and Operation:** Constructional detailsof4 stroke petrol engine. Working principle, Otto cycle, and actual indicator diagram. Two stroke engine construction and operation. Comparison of four stroke and two-stroke engine operation. Firing order and its significance. **SI Engine Fuel System:** Carburettor working principle. Requirements of an automotive carburettor; Starting, idling, acceleration and normal circuits of carburettors, compensation, Maximum power devices, constant choke and constant vacuum carburettors. Fuel feed systems, Mechanical and electrical pumps, Petrol injection. **Diesel cycle**: Fuel- air and actual cycle analysis. Diesel fuel, Ignition quality. Cetane number, Fuel Injection System: Requirements, Air and solid injection, function of components, Jerk and distributor type Pumps. Pressure waves, Injection lag, Unit injector, Mechanical and Pneumatic governors. Fuel injector-types of injection nozzle, Spray characteristics, injection timing, pump calibration.	22
II	**Cooling and Lubrication System:** Need for cooling system. Types of cooling system, Liquid cooled system, Thermo-syphon system, and Pressure cooling system. Lubrication system, Mist lubrication system, Wet sump and dry sump lubrication. Properties of lubricants. Properties of coolants. **Combustion and Combustion Chambers:** Combustion in SI &CI engines, stages of combustion, flame propagation, rate of pressurise, abnormal combustion, knocks. Effect of engine variables and knock. Combustion chambers, Different types, Factor controlling combustion chamber design. **Diesel Engine Testing and Performance:** Methods to improve engine performance. Heat balance. Performance maps. Supercharging and Turbocharging: Necessity and limitation, Charge cooling, Types of supercharging and turbo charging, relative merits, matching of turbocharger	23

Text Books :

- V. Ganeshan, "Internal Combustion Engines": Tata McGraw-Hill, 2015.
- V. Ganeshan, "Gas Turbines": Tata McGraw-Hill, 2013.
- W. W. Pulkrabek, "Engineering fundamental of the I.C.Engine": PHI, India, 2012.

Reference Books:

- E. F. Obert, "Internal Combustion Engines & Air pollution": Hopper & Row Publication New York, 2011.
- John B. Heywood, "Internal Combustion Engines Fundamentals": McGraw Hill, New York, 2013.
- E. F. Obert,"International Combustion Engines Analysis and Practice": International Text Book Co.,Scranton,Pennsylvania,1988.
- Wiliam. H. Crouse, "Automotive Engines": McGraw HillPublishers,1985.
- H. E. Ellinger,"Automotive Engines": Prentice Hall Publishers,1992.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:*After studying these topics, the student will be able to*

CO1:*Understand the construction and operation of 2 Stroke and 4 Stroke Petrol Engine*
CO2:*Know the fuels and Combustion in SI Engines*
CO3:*Understand and evaluate physical parameters of engine design and operating characteristics*
CO4:*Knowledge of Lubrication and Cooling systems*
CO5:*Apply the fundamental knowledge of solving air-standard and real air-fuel engine cycles.*

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1
CO3	PO1,PO3/PSO1
CO4	PO1,PO3,PO3/PSO1,PSO2
CO5	PO1,PO2,PO3/PSO1,PSO3

BMEC 0020: AUTOMOTIVE CHASSIS AND TRANSMISSION SYSTEM

Objectives: *To familiarize the students with the fundamentals of Automobile Chassis and automotive transmission system.*

Credits: 03 **Semester: V** **L–T–P: 3-0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Introduction:** Types of chassis layout with reference to power plant locations and drive. Vehicle frames. Various type of frames. Constructional details. Materials Testing of vehicles frames. Unitised frame body construction, Loads acting on vehicle frame. **Front axle and Steering System:** Types of front axle. Constructions details Materials. Front wheel geometry viz. Castor, Camber, Kingpin inclination, Toe-in. Conditions for true rolling motion of wheels during steering. Steering geometry. Ackerman and Davis steering system. Constructional details of steering linkages. Different types of steering gear boxes. Steering link age sand layouts. Power and Power assisted steering. Steering of crawler tractors. **Drive Line:** Effect of driving thrust and torque reactions. Hotch-Kiss drive, torque tube drive and radius rods. Propeller shaft. Universal joints. Constants velocity universal joints. Front wheel drive.Final Drive Differential: Different types of final drive. Worm and worm wheel, Straight bevel gear, Spiral bevel gear and hypoid gear final drives.Double reduction and twin speed final drives.Differentialprinciples.Construction details of differential unit.Non-slip differential. Differential locks, Differential housings. Rear Axles: Construction of rear axles.Types of loads acting on rear axles. Full floating. Three quarter floating and semi floating rear axles. Rear axle housing. Construction of different types of axle housings.Multi-axlesvehicles.	23
II	**Suspension System:** Need of suspension system, types of suspension, suspension springs, constructional details and characteristics of leaf,coil and torsion bar springs .Independent suspension, Rubber suspension, Pneumatic suspension, Shock absorbers. **Braking System:** Classification of brakes, drum brake& disc brakes. Constructional details-Theory of braking. Mechanical, hydraulic and Pneumatic brakes. Servo brake. Power and power assisted brakes-different types of retarders like eddy current and hydraulic retarder. Antilock braking systems. **Automotive Transmission:** Ford—T-model gearbox, Wilson gearbox,	22

	Electro-magnetic transmission, Automatic over drive, Hydraulic control system for automatic transmission. Hydrostatic Drive and Electric Drive: Hydrostatic drive; various types of hydrostatic drive systems-Principles of hydrostatic drive system, Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive.	

Text Books :

- Newton. Steeds &Garrot, "Motor Vehicles": Butter worths,London,1983.
- A. W. Judge, "Mechanism of the car": Chapman and Halls Ltd., London, 1986.
- P. M. Heldt, "Automotive Chassis": Chilton Co.,NewYork,1990.

Reference Books:

- W. H. Crouse and Anglin, "Automotive Transmission and Power Trains Construction": McGraw-Hill, 2003.
- W. H. Crouse, "Automotive Chassis andBody": McGrawHillNewYork,1971.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes: *After studying these topics, the student will be able to*

CO1:*Know the basics of Automobile Chassis Components.*
CO2:*Understand construction and Working principle of Front Axle, Rear Axle.*
CO3:*UnderstandConstruction and Working principle of Final Drive, Steering System.*
CO4:*UnderstandConstruction and Working principle of Brakes and Suspension System*.
CO5:*Know about the hydrostatic drive and electric drive in automobiles, their principle of operation.*

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO3
CO2	PO2,PO3/PSO1
CO3	PO1,PO3/PSO1
CO4	PO1,PO3,PO4/PSO1,PSO2
CO5	PO1,PO2/PSO1,PSO3

BMEC 0018: AUTOMOTIVE ELECTRICAL & ELECTRONIC SYSTEM

Prerequisites: Kinematics of Machines.
Objectives: *To provide knowledge about application of electrical and electronics in automobile engineering.*

Credits: 03 **Semester: VI** **L–T–P: 3-0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Batteries:** Principles and construction of lead-acid battery. Characteristics of battery, rating capacity and efficiency of batteries. Various tests on battery condition, charging methods. Constructional aspect of alkaline battery. Starting System: Condition at starting. Behaviour of starter during starting. Series motor and its characteristics. Principle & construction of starter motor. Working of different starter drive units, care and maintenance of starter motor. Starter Switches. **Charging System:** Generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cut-out. Voltage & current regulators. Compensated voltage regulator alternators principle & constructional aspects and bridge benefits. Ignition Systems: Types, Construction & working of battery coil and magneto ignition systems. Relative merits, Centrifugal and vacuum advance mechanisms, types and construction of spark plugs, electronic ignition systems. **System & Accessories:** Insulated & earth return systems. Positive & negative earth systems. Details of head light & side light. Headlight dazzling & preventive methods. Electrical fuel-pump, Speedometer, Fuel, oil & temperature gauges, Horn, Wiper system, Trafficator.	23
II	**Automotive Electronics:** Current trends in modern automobiles, Open and close loop systems-Components for electronic engine management. Electronic management of chassis system. Vehicle motion control. Sensors and Actuators: Basic sensor arrangement, Types of sensors such as-Oxygen sensors, Crank angle position sensors- Fuel metering/vehicle speed sensor and detonation sensor-Altitude sensor, flow sensor. Throttle position sensors. Solenoids, stepper motors, and relays. **Electronic Fuel Injection and Ignition Systems:** Introduction, feedback carburettor systems. Throttle body injection and multi-port or point fuel injection.Fuel injection systems, Injection system controls.	23

	Advantages of electronic ignition systems: Types of solid-state ignition systems and their principle of operation, Contact less electronic ignition system, and electronic spark4 timing control. **Digital Engine Control System:** Open loop and closed loop control systems - Engine cranking and warm up control-Acceleration enrichment-Deceleration leaning and idle speed control. Distributor less ignition-Integrated engine control systems, Exhaust emission control engineering. Electronic dashboard instruments-On-board diagnosis system, security and warning system.	

TextBooks:

- P. L. Kholi, "Automotive Electrical Equipment": Tata McGraw-Hill Co. Ltd. New Delhi, 1975.
- W. B. Ribbens, "Understanding Automotive Electronics": 5th Edition, Butterworth, Heinemann Woburn, 1998.
- R. N. Brady, "Automotive Computers and digital Instrumentation": Prentice Hall, Eagle Wood Cliffs, New Jersy, 1988.

Reference Books:

- A. W. Judge, "Modern Electrical Equipment of Automobiles": Chapman & Hall, London, 1992.
- A. P. Young. & L. Griffiths, "Automobile Electrical Equipment": English Language Book Society & New Press, 1990.
- W. H. Crouse, "Automobile Electrical Equipment": McGraw Hill Book Co Inc., New York, 1980.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes: *After studying these topics, the student will be able to*
CO1:*Understand importance of electrical systems in Automobile and number of subsystems like starting system, charging system etc.*
CO2:*Know about conversion of mechanical to electronics systems.*
CO3:*Understand function and construction of various electrical, electronic components and system.*
CO4:*Understand of various types of sensors.*
CO5:*Analyse injection and ignition systems with new technologies.*

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1,PSO2
CO3	PO1,PO3/PSO1,PSO2

CO4	PO1,PO3,PO4/PSO1
CO5	PO1,PO2,PO3/PSO1

BMEC 0810: AUTOMOTIVE ELECTRICAL & ELECTRONIC SYSTEM LAB

Objectives: To provide knowledge about application of electrical and electronics in automobile.

Credits: 01 **Semester: VI** **L–T–P: 0-0-2**

Module No.	**LIST OF EXPERIMENTS**	**Teaching Hours** (Approx.)
	1. To study of rectifier and filters 2. Testing of starting motors and generators 3. Diagnosis of ignition system faults 4. Study of Automobile electrical wiring. 5. Study of logic-gates, adder and flip-flops 6. Study of SCR and ICtimer 7. Interfacing A/D converter and simple data acquisition 8. Microcontroller programming and interfacing	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes: *After studying these topics, the student will be able to*

CO1:*Explain different kinds of automotive wiring.*
CO2:*Describe the action of basic electric circuits.*
CO3:*To understand the basics of instrumentation, measurement, data acquisition, interpretation and analysis***.**
CO4:*To learn rectifiers, filters, A/D and D/A convertors.*

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO1
CO2	PO2,PO3/PSO1
CO3	PO1,PO3/PSO1,PSO2
CO4	PO1,PO3,PO4/PSO1,PSO2

BMEC 0019: VEHICLE BODY AND DYNAMICS

Objectives: *This course provides the basic knowledge about construction & various types of automotive bodies. On completion of this course, the students are exposed to understand the concept of body construction techniques under the light of aerodynamics.*

Credits: 03 **Semester: VI** **L–T–P: 3-0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Car Body Details**: Types:Saloon,Convertibles,Limousine,Estatevan,racingandsportscar. Visibility: regulations, driver'svisibility, test for visibility, Methods of improving visibility and spaceincars. Safety:safety design, safety equipment's for car.Car body construction. **Vehicle Aerodynamics:** Objectives, Vehicle drag and types, various types of forces and moments, Effects of forces and moments, side wind effects on forces and moments, various body optimization techniques for minimum drag. **Wind tunnel testing:** Flow visualization techniques, scale model testing. Component balance to measure force sand moments.	20
II	**Bus Body Details:** Types, minibus, single decker, double decker, two level,split level and articulated bus. Bus Body Lay-Out: Floor height, engine location, entrance and exit location, seating dimensions. **Constructional details:** Frame construction, Double skin construction-Types ofmetalsectionused-Regulations-ConventionalandIntegraltypeconstruction. **Commercial Vehicle Details:** Types of body, Flat platform, drop side,fixed side, tipper body, tanker body. Light commercial vehicle body types, Dimensions of driver's seating relation to controls, driver's cabin design. Body Materials, Trim And Mechanisms: Steel sheet, timber, plastics, GRP, properties of materials-Corrosion anti-corrosion methods, scalation of paint and painting process, body trim items. Body mechanisms.	23

Text Books :

- J. B. Braithwaite, "Vehicle Body building and drawing": Heinemann Educational Books Ltd., London,1977.
- J. Fenton, "Vehicle Body layout and analysis": Mechanical Engg Publication Ltd., London, 1982.

Reference Books:

- J. Powloski, "Vehicle Body Engineering": Business Books Ltd., 1989.
- J. C. Giles, "Body construction and design": III iffe Books Butterworth & Co., 1971.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes: *After studying these topics, the student will be able to*

CO1:*To expose the fundamentals in various automotive body construction techniques.*
CO2:*To integrate the concepts of aerodynamics in body engineering for better style and low drag.*
CO3:*Understand the various types of bus body construction, seating layout, regulations and comfort.*
CO4:*Understandthe various heavy vehicle bodies, driver's visibility and cabin design.*
CO5:*Know the different types of materials and painting techniques for vehicle body*.

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2/PSO1
CO2	PO1,PO2,PO3/PSO1,PSO2
CO3	PO1,PO3/PSO1
CO4	PO1,PO3/PSO1
CO5	PO1,PO2,PO3/PSO1,PSO2

BMEC 0021: AUTOMOTIVE ENGINEERING

Objective: *To study function of various components in automotive vehicles and safety consideration in vehicles. To study clutches, power suspension, brakes, drive lines, universal joints, steering system, construction and working of hybrid vehicles.*

Credits: 04 **Semester VII/VIII** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Automobiles :**Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles. **Clutches : Requirement of Clutches** – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages. **Suspension Systems:** Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs.	26
II	**Steering System :**Front Wheel geometry & Wheel alignment viz. Caster, Camber, King pin Inclination, Toe-in/Toe-out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack & Pinion Power Steering Gear, Electronics steering. **Automotive Brakes, Tyres&Wheels :** Classification of Brakes; Principle and constructional details of Drum Brakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre& their constructional details, Wheel Balancing, Tyre Rotation; Types of Tyre wear & their causes. **Hybrid Automotive Vehicles**: Introduction to Hybrid Vehicle, Construction and working of hybrid vehicles, working of fuel cell vehicle, vehicular fuel cell system: fuel cell stack, fuel cell engine auxiliaries, electric drive system; benefits of hybrid vehicles, fuel supply, storage and processing in fuel cells.	24

Text Books:

- Automobile Engineering by Anil Chhikara, SatyaPrakashan, New Delhi.
- Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.
- Automobile Engineering by D.S.Kumar, S.K.Kataria and Sons, New Delhi.

Reference Books:

- John Turner, 'Automotive Sensors', Momentum press, LLC NEW YORK ISBN- 9781606500095 ,ISBN- 1606500090, 2009.
- Barbara J. Peters, George A. Peters, 'Automotive Vehicle Safety', SAE International and Taylor & Francis ISBN - 978-0-7680-1096-1, London, 2002.
- J. Marek, H.-P. Trah Sensors, 'Automotive Technology', Y.Suzuki, I. Yokomor / ISBN – 3527295534 Wiley-vch ,weinheim, 2003.
- Jeff Daniels, 'Modern Car Technology', J Haynes & Co. Ltd., 2009

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome:* *At the end of the course, a student will be able to

CO1. Understand the principle of automobiles drive and advances in automobiles. ***(Understand)***
CO2. *Explain the concept of various types of clutch* ***. (Understand)***
CO3 Describe various types of steering system along with merits and demerits. ***(Understand)***
CO4 Identify and describe various types of hybrid vehicles. ***(Analyze)***
*CO5 Demonstrate about various types of Suspension system (****Understand)***

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	POs/PSOs
CO1	PO1, PO3, PO6, PO12/ PSO1
CO2	PO1, PO3, PO4, PO6, PO10/ PSO1
CO3	PO2, PO3, PO4, PO6/ PSO1
CO4	PO2, PO3, PO4, PO6/ PSO1
CO5	PO3, PO6, PO9/ PSO1
CO6	PO1, PO3, PO6, PO9/ PSO1

BMEC 0811: AUTOMOTIVE ENGINEERING LAB

Objective: *To study function of various components in automotive vehicles and safety consideration in vehicles. To study clutches, power suspension, brakes, drive lines, universal joints, steering system.*

Credits: 01 **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	List of Experiments: • To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems. (a) Multi-cylinder: Diesel and Petrol Engines. (b) Engine cooling & lubricating Systems. (c) Engine starting Systems. (d) Contact Point & Electronic Ignition Systems. • To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems: (a) Carburetors (b) Diesel Fuel Injection Systems (c) Gasoline Fuel Injection Systems. • To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches. (a) Coil-Spring Clutch (b) Diaphragm – Spring Clutch. (c) Double Disk Clutch. • To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems. (a) Synchromesh – Four speed Range. (b) Transaxle with Dual Speed Range. (c) Four Wheel Drive and Transfer Case. (d) Steering Column and Floor – Shift levers. • To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials. (a) Rear Wheel Drive Line. (b) Front Wheel Drive Line. (c) Differentials, Drive Axles and Four Wheel Drive Line. • To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems. (a) Front Suspension System. (b) Rear Suspension System. • To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems. (a) Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering. (b) Power steering Systems, e.g. Rack and Pinion Power Steering System. (c) Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.	

	• To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres& wheels. (a) Various Types of Bias & Radial Tyres. (b) Various Types of wheels. • To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems. (a) Hydraulic & Pneumatic Brake systems. (b) Drum Brake System. (c) Disk Brake System. (d) Antilock Brake System. (e) System Packing & Other Brakes. • To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems. • 11. Diagnosis of ignition system faults • 12. Study of Automobile electrical wiring.	

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: Students have studied about:

At the end of the course, a student will be able to

1. Understand about different types of automotive transmission system**.(Understand)**
2. Understand different types of automotive suspension system.**(Understand)**
3. Learn about different types of steering system (**Understand).**
4. Understand different types of automotive brake system (**Understand)**

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	***POs/PSOs***
CO1	PO1, PO2, PO3, PO4, PO6, PO12/ PSO1
CO2	PO1,PO2/PSO1
CO3	PO2,PO3/PSO1
CO4	PO1,PO3, PO4/PSO1,PSO2

BMEC 0022: TWO AND THREE WHEELERS

Pre- Requisite:- **Automobile System**

Objective: *The course is designed to understand different types of two and three wheelers types, construction and working. Students will also be able to learn about different functions of two and three wheelers.*

Credits: 03 **Semester: VII/ VIII** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**UNIT I** **Power Unit:** Two stroke and four stroke SI engine, merits and demerits. Symmetrical and unsymmetrical port timing diagrams. Types of scavenging process merits and demerits, scavenging efficiency. Scavenging pumps. Rotary valve engine, Fuel system. Lubrication system. **UNIT II** Magneto coil and battery coil spark ignition system, electronic Ignition system. Starting system. Kick starter system. **UNIT III** **Chassis and Sub-Systems:** Main frame, its types. Chassis and shaft drive. Single, multiple plates and centrifugal clutches. Gearbox and gear controls. Front and rear suspension-systems, Shock absorbers Panel meters and controls on handle bar.	20
II	**UNIT IV** **Brake and Wheels:** Drum brakes, Disc brakes, front and rear brake links layout, Spoked wheel, Cast wheel. Disc wheel. Disc types. Tyres& tubes. **UNIT V** **Two Wheelers:** Case study of major Indian models of motorcycles, SCOOTERS AND MOPEDS. Bajaj, Vespa, Lambretta scooters. Enfield, TVS-Suzuki, Hero-Honda, Yamaha RX100, Kawasaki Bajaj Motorcycle. Kinetic Spark, Hero Majestic, TVS mopeds. Servicing and maintenance. **UNIT VI** **Three Wheelers:** Case study of Indian Models. Front engine and rear engine. Auto rickshaws. Pick-up van. Delivery Van and Trailer.	24

Text Book:

- Irving. P.E., Motorcycle Engineering, Temple Press Book,London,1992.
- The Cycle Motor Manual, Temple Press Ltd., London, 1990.
- Encyclopedia of Motorcycling, 20 volumes, Marshall Cavensih, New York and London, 1989.
- Bryaut. R.V., Vespa Maintenance and Repair series.
- Raymond Broad, Lambretta-A practical guide to maintenance and repair,1987

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: At the end of the course, a student will be able to

CO1. Understanding & learning different types of two and three wheelers ***(Understand).***

CO2. *Explain & analyze special parts and their importance and working in two and three wheelers* ***(Analyze).***

CO3 Identify & understand maintenance of two and three wheelers ***(Understand).***

CO4.Understand the various subsystem of two wheeler and also know how it is different from light motors and heavy motor vehicles. ***(Understand)***

CO5 Understand the various subsystem of three wheeler and also know how it is different from light motors and heavy motor vehicles. ***(Understand)***

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	POs/PSOs
CO1	PO1, PO3, PO6, PO12/ PSO1
CO2	PO1, PO3, PO6, PO10/ PSO1
CO3	PO2, PO3, PO4, PO6/ PSO1, PSO2
CO4	PO2, PO3, PO4, PO6/ PSO1
CO5	PO1, PO3, PO6, PO10/ PSO1, PSO2

BMEE________: VEHICLE PERFORMANCE AND TESTING

Objective: *The course is designed to familiarize the students in vehicle testing and performance.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**VEHICLE PERFORMANCE ESTIMATION & PREDICTION:** Aerodynamic drag, methods of estimation of resistance to motion, power requirement for propulsion, Power plant characteristics & transmission related requirements, arrangement of power train, vehicle controls, vehicle acceleration, maximum speed, and grade-ability drive systems comparison, hill climbing, handling and ride characteristics on different road surfaces. Effect of pressure, temperature and humidity on power output. **VEHICLE TRANSMISSION PERFORMANCE:** Characteristics & features of friction clutches, mechanical gear transmission & epicyclic gearboxes. **OPERATIONAL PERFORMANCE:** Engine performance & operating characteristics, Operation at full load and part load conditions, fuel economy, effect of vehicle condition, tyre and road condition, traffic condition and driving habits on fuel economy, vehicle safety.	20
II	**CONTROL SYSTEMS:** Braking arrangements & Characteristics, weight transfer, steering arrangements, rigid & independent suspension, roll centre, torsion bar, stabilizer, radius bar. **VEHICLE PERFORMANCE TESTING:** Testing of major components of vehicle like clutch, suspension, braking, steering etc., Engine testing – noise, vibrations, emission, power & fuel consumption, Vehicle testing on chassis dynamometers, Road and Track Testing, Initial inspection, running in and durability, extensive driving, maximum speed & acceleration, Brake testing on the road, Hill climbing, handling & ride characteristics on different road surfaces, ride comfort. **ACCELERATION AND BRAKING PERFORMANCE:** Longitudinal performance - Load transfer due to driveline torque – Transient Behavior - Simple IC engine modeling - Polynomial fits - ODE input-output models - Braking Performance - Transient behavior - Quarter car models - Half car models - 2 and 4 degree of freedom - Dynamic weight shift - Anti-lock brakes -Braking Stability.	24

Text Book:

- Martyr A. J, Plint M. A, *"Engine Testing Theory and Practice"*, 3rd edition, Butterworth-Heinemann, 2007.
- Gousha H. M, *"Engine Performance Diagnosis & Tune Up Shop Manual"*.
- Giles J. G, *"Vehicle Operation & Performance"*.
  Crouse. W. H, Anglin. D. L, *"Motor Vehicle Inspection"*, McGraw Hill, 1978.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: At the end of the course, a student will be able to

CO1. Know the concept of vehicle performance estimation. ***(Understand).***

CO2. *Know the concept of vehicle performance testing.**(Understand).***

*CO3.Know about transmission performance.**(Understand).***

*CO4.Know about the Laboratory testing of vehicles.**(Understand)***

CO5.About the stability of vehicle. ***(Understand)***

Mapping of Course Outcomes (Cos) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) :

COs	POs/PSOs
CO1	PO1, PO3, PO6, PO12/ PSO1
CO2	PO1, PO3, PO6, PO10/ PSO1
CO3	PO2, PO3, PO4, PO6/ PSO1, PSO2
CO4	PO2, PO3, PO4, PO6/ PSO1
CO5	PO1, PO3, PO6, PO10/ PSO1, PSO2

BMEE________: NEW GENERATION AND HYBRID VEHICLES

Credits: 03 **Semester: VII** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**INTRODUCTION:**Electric and hybrid vehicles, flexible fuel vehicles (FFV), solar powered vehicles, vehicles, fuel cells vehicles. **POWER SYSTEM AND NEW GENERATION VEHICLES:** Hybrid Vehicle engines, Stratified charge engines, learn burn engines, low heat rejection engines, hydrogen engines, HCCI engine, VCR engine, surface ignition engines, VVTI engines. High energy and power density batteries, fuel cells, flexible fuel systems. **VEHICLE OPERATION AND CONTROL:** Computer Control for pollution and noise control and for fuel economy – Transducers and actuators - Information technology for receiving proper information and operation of the vehicle like optimum speed and direction.	25
II	**VEHICLE AUTOMATED TRACKS:** Preparation and maintenance of proper road network - National highway network with automated roads and vehicles - Satellite control of vehicle operation for safe and fast travel, GPS. **SUSPENSION, BRAKES, AERODYNAMICS AND SAFETY:** Air suspension – Closed loop suspension, compensated suspension, anti-skid braking system, retarders, regenerative braking, safety gauge air bags- crash resistance. Aerodynamics for modern vehicles, safety systems, materials and standards.	20

Text Book:

- Bosch Hand Book, SAE Publication, 2000
- Heinz, "Modern Vehicle Technology" Second Edition
- Advance hybrid vehicle power transmission, SAE.
- Light weight electric for hybrid vehicle design.
- Noise reduction, Branek L.L., McGraw Hill Book company, New York, 1993

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

***Course Outcome:* At the end of the course, a student will be able to**

*CO1. Understand therecent development pertain to energy system.**(Understand)***

CO2. *Explain various operation of Hybrid vehicles and new generation vehicles.* ***(Understand)***

*CO3 Understand the working of GPS and satellite control of vehicle operation for safe and fast travel.**(Understand)***

*CO4 Demonstrate the application of computer for controlling pollution and noise for better fuel efficiency.**(Apply)***

*CO5 Explain recent technologies in the area of suspension systems, brakes, aerodynamics etc.**(Understand)***

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1, PO3, PO6, PO12/ PSO1
CO2	PO1, PO3, PO4, PO6, PO10/ PSO1
CO3	PO2, PO3, PO4, PO6/ PSO1
CO4	PO2, PO3, PO4, PO6/ PSO1
CO5	PO1, PO3, PO6, PO10/ PSO1

BMEE_________: TROUBLE SHOOTING, SERVICING AND MAINTENANCE OF AUTOMOBILES

Objective:*To study function of various components in automotive vehicles and safety consideration in vehicles. To input knowledge on Vehicle Trouble shooting and maintenance.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**INTRODUCTION AND TROUBLE SHOOTING:** Check list on trouble shooting - Engine, clutch, gear box, rear axle, front axle, steering, electrical systems - Trouble shooting on engine management system -On board diagnosis using multi-scanner - Testing of SI engine using computerized engine analyzer. **MAINTENANCE OF WORKSHOP, ITS SCHEDULE AND RECORDS:**Importance of maintenance - schedule and unscheduled maintenance - scope of maintenance - vehicle down time - vehicle inspection, reports, log books, trip sheet. **ENGINE REPAIR AND OVERHAULING:** Dismantling of SI & CI engines and its components - Cleaning methods -inspection and checking - repair and reconditioning methods for all engine components - Maintenance of ignition system - fuel injection system – cooling system, lubrication system - Design trouble shooting chart for MPFI & CRDI Engines.	21
II	**MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS:**Maintenance - servicing and repair of clutch, fluid coupling, gear box, torque converter, propeller shaft - Maintenance of front axle, rear axle, brakes, steering systems, tyre. **MAINTENANCE AND REPAIR OF VEHICLE BODY:**Body panel tools for repairing - Tinkering and painting - Use of soldering, metalloid paste. **MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS AND FLEET MAINTENANCE MANAGEMENT:**Service, maintenance, testing and trouble shooting of battery, starter motor,alternator rectifier and transistorized regulator.Fleet maintenance requirement - investment and costs, types of work shop layout,tools and equipment - spare parts and lubricants stocking, manpower, training,workshop management, warranty, replacement policy.	24

Text Book:

- Martin W. Stockel, Martin T. Stockel, Chris Johanson, "*Auto Service & Repair: Servicing, Troubleshooting, and Repairing Modern Automobiles: Applicable to All Makes and Models*", Goodheart-Willcox Publisher, 1996.

- Vaughn D. Martin, *"Automotive Electrical Systems: Troubleshooting and Repair Basics"*, Prompt Publications, 1999.
- Crouse W., *"Everyday Automobile Repair"*, Intl. student edition, TMH, New Delhi, 1986.
- James D. Halderman, "Chase D. Mitchell, "*Automotive steering, suspension, and alignment"*, Prentice Hall, 2000.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: At the end of the course, a student will be able to

1. *Know about vehicle trouble shooting.*
2. *Enabling students to operate and manage maintenance workshops.*
3. *Maintenance of shop, its schedule and prepare record.*
4. *Repair and overhauling of engine, chassis vehicle body.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	***POs/PSOs***
CO1	PO1, PO2, PO3, PO4, PO6, PO12/ PSO1
CO2	PO1,PO2/PSO1
CO3	PO2,PO3/PSO1
CO4	PO1,PO3, PO4/PSO1,PSO2

BMEE________: AUTOMOBILE AIR CONDITIONING

Objective:*This course aims at providing adequate knowledge about air conditioning system in automobiles since it has now become an integral part of a vehicle and the whole of South India and parts of the North witness intense heat during summers.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**REFRIGERATION**: Introduction; methods of refrigeration; vapour compression refrigeration system; vapour absorption refrigeration system; applications of refrigeration and air conditioning; Automobile air conditioning; air conditioning for passengers; isolated vehicles; transport vehicles; applications related with very low temperatures. **REFRIGERANT**: Classification; properties; selection criteria; commonly used refrigerants; alternative refrigerants; eco-friendly refrigerants; applications of refrigerants; refrigerants used in automobile air conditioning. **PSYCHOMETRY**: Psychometric properties; tables; charts; psychometric process; comfort charts; factors affecting comfort; effective temperature; ventilation requirements.	20
II	**AIR CONDITIONING SYSTEMS**: Classification; layouts; central / unitary air conditioning systems; components like compressors; evaporators; condensers; expansion devices; fan blowers; heating systems etc. **LOAD ANALYSIS**: Outside and inside design consideration; factors forming the load on refrigeration and air conditioning systems; cooling and heating load calculations; load calculations for automobiles; effect of air conditioning load on engine performance. Distribution duct system; sizing supply / return ducts; type of grills; diffusers; ventilation; air noise level; layout of duct systems for automobiles and their impact on load calculations. **AIR ROUTINE and TEMPERATURE CONTROL**: Objectives: evaporator care air flow through the dash re-circulating unit; automatic temperature control; controlling flow; control of air handing systems.	22

Text Book:

- Paul Lung., “Automotive Air Conditioning”, C.B.S Publisher and Distributor
- American Society of Heating, Refrigeration and Air Conditioning, “ASHRAE Handbook – Fundamentals”, 1985.
- "Heating and Air Conditioning Systems”, Mitchell Information Services.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: ***At the end of the course, a student will be able to***

CO1. Understand the air refrigeration, vapor compression refrigeration, vapor absorption, steamjet refrigeration systems and different type of refrigerants.

CO2. *Expedite the working of single stage, multistage and cascade refrigeration.*

CO3. Knowledge of psychometric and different psychometric processes. Understand and evaluate cooling and heating load and design of HVAC system.

CO4. Develop and design RAC systems and evaluate different expansion and control devices.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO3
CO2	PO2,PO3/PSO1
CO3	PO1,PO3/PSO1
CO4	PO1,PO3,PO4/PSO1,PSO2

BMEE0006: GAS TURBINE AND JET PROPULSION

Pre-requisite: *Applied Thermodynamics*

Objective: Students will be able to understand propulsion systems in aircraft that are essential to graduateengineers who are intended to work in aircraft system/component manufacturing/maintenance environments.Students should be able todescribe thekeyaeronautical engineering featuresin the contextofwhichtherelevant industryoperates.

Credits:04 **L–T–P:3–1–0**

ModuleNo.	Content	TeachingHours
I	**IntroductiontoGasTurbine:**SimplegasturbineandreviewofBraytoncycle. **CycleArrangements:**Opencyclearrangement,closedcyclearrangement. Basicrequirementsofworkingmediumanditsproperties. **Idealcyclesandtheiranalysis:**Simplegasturbinecycle,heatexchange cycle, reheat cycle, intercooled cycle, combinations of variouscycles,comparisonof variouscycle. **Impulseturbineandreactionturbines:**Introductiontoimpulseturbineandreactionturbines,Multistagemachine,compoundingofturbines.	22
II	**Elementary turbine design:** Velocity triangleofsinglestageturbine,Expressionforworkoutput,bladeloadingand flowcoefficients,bladeand stage efficiencies, Blade to gas speed ratio, losses and efficiencies.**Aircraft Propulsion:** Introduction, types ofaircraftenginesandtheiranalysis(gasturbineengines,turbojetengines,turbofanengines,turbopropengines) **Aircraftpropulsiontheory:**Thrust,thrustpower,propulsiveefficiency,ram efficiency,thermalefficiencyandoverallefficiency.	23

TextBooks:

- CohenandRogers,'GasTurbineTheory',DorlingKindersley(India)pvt.Ltd.,Noida.
- V.Ganesan,'GasTurbines',TataMcGrawHills,NewDelhi.
- S.M.Yahya,'Turbines,Compressorsandfans',McGrawHills,NewDelhi.

Reference Books:

- JackD.Mattingly,'ElementsofGasTurbinePropulsion',TataMcGrawHills,NewDelhi.
- Mathur and Sharma,'GasTurbineandJet&RocketPropulsion',Standardpulishers,Delhi.
- AhmedandSayed,'AircraftpropulsionandGasTurbineEngines'CRCpress,TaylorandFrancis.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: After completion of course, the student will be able to:

- **CO1:**Outlinegoverningequationsofcompressiblefluidflow.
- **CO2:**Analyzeonedimensionalcompressibleflowthroughvariableareaduct.
- **CO3:**Analyzecompressibleflowhavingnormalshock.

- **CO4:**Applygoverningequationstocompressibleflowthroughconstantareaduct withfriction.
- **CO5:**Applygoverningequationstocompressible flowthroughconstantareaductwithheattransfer.
- **CO6:**Interpretpropulsivesystemsfortheir workingandapplication.

MappingofCourseOutcomes(COs)withProgramoutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO2,PO4/PSO3
CO2	PO2,PO3/PSO3
CO3	PO2,PO4/PSO3
CO4	PO2,PO4/PSO3
CO5	PO2,PO3/PSO3
CO6	PO3,PO4/PSO3

BME E 0008 SOLAR ENERGY

CREDIT: 03 **L- T –P-J: 3-0- 0-0**

Course objective:

Solar energy is ultimate energy resource available on planet earth. Objective of this course is to makestudents aware about many facets of solar energy. How solar energy can be harnessed for variousapplications. Ultimate objective of this course is to train students about integration of solar energydevicesinbuildings,agriculturalandothermechanizedmeans.

Module No.	Content	Teaching Hours
I	**Introduction:**generalintroductiontorenewableenergytechnology,Solarenergypotentialin India, energy demands and renewable energy. current and future scenario.**Solarradiation**:Directanddiffusedradiation,Radiationmeasuringequipment.Basics ofsolarangles. **Solarcollectors**:basicworkingofcollectors,FPSC,PTC,Solarconcentrators, tracking mechanism,Solar energy storage systemsdesignsandperformanceanalysisbased onstandard norms. **Applications** in water heating systems, steam generating with solarenergy.Phase changingmaterialsforenergystorage	20
II	Solarairheatingsystems,Spaceheatingandcoolingprocesses PV Systems,hybrid PV/Tsystems.Renewableenergy desalinationsystems.Energyconversionsystemsbasedonbio-mass,Photosynthesisbasic conceptandworkingoffuelcell. Active & Passive building applications. Economics (IRR, LCOE,ROI)Design,modelingand simulationofsolarenergysystems.	22
	Totalhours	**42hours**

Text Books:

- S.PSukhatmeandJ.KNayak.“Solarenergy,principleofthermalcollectionandstorage”
- S. Kalogirou “Solarenergyengineering:processesandsystems.”ISBN978-0-374501-9

Reference Books:

- YogiGoswami“PrincipleofSolarengineering”, CRCPress,Thirdedition.
- J.ADuffie&W.ABeckman“Solarengineering&thermalprocesses”JohnWiley&Sons,4ed.
- G.NTiwari“Solarenergy:Fundamental,design,ModelingandApplications”ISBN-10:0849324092
- C.P.Arora“Refrigerationandairconditioning”TataMcgraw-Hill PublishingCompany,2ndEd.

Focus: *This course focuses on Employability/Skill development and aligned with CO's* 1 and 2

Outcome:

CO1**.** Understand working of solar radiation measuring equipments

CO2. Determine magnitude of incident radiation.

CO3. Understand working of solar collector systems.

CO4. Apply knowledge to design improved solar energy based systems.

CO5. Analyze processes of space heating and cooling systems.

CO6.Canper form modeling and simulation for performance analysis to optimize the system efficiency.

CO7. Design and develop small solar energy based systems suitable for rural areas.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PSO1
CO2	PO4/PSO1
CO3	PO1,PSO1
CO4	PO3,PO5,PSO1,PSO2
CO5	PO7,PO9,PO3,PSO1,PSO3
CO6	PO3,PO4,PO5,PSO1,PSO3
CO7	PO3,PO6,PO7,PO10,PO12,PSO1,PSO3

BMEE0172 SOLAR ENERGY LAB

Objective: *Todevelopthecapabilityofstudentstounderstandsolarenergyharvestingsystemsandtoapplyacquiredknowledgetofulfillthesocialneeds.*

Credits:01 **L–T–P-J:0–0–2-0**

Exp.No	Experimentobjective	Hours
1	TodeterminethermalefficiencyofFPSCinindoorcondition	2
2	TodeterminethermalefficiencyofFPSCinnaturalmode	2
3	Todeterminethermalefficiencyofsingleaxisparabolictrough collector	2
4	TodeterminethermalefficiencyofPTC (doubleaxis)	2
5	Determinethermalefficiencyofsolarairheatingsystem	2
6	Todeterminecharginganddischargingefficiencyofenergy storagesystem.	2
7	Todetermineoverallheat transfercoefficient ofenergystorage system.	2
8	Todetermineoverallheat transfercoefficient ofFPSC.	2
9	Tostudysolartrackingsysteminparabolictroughcollector	2
10	Toanalyzethethermalperformanceofheatpipeuseinsolar collectorsystem.	2
11	Tostudyworking ofPV/Tsystemforsolarenergyabsorption	2
12	Tostudyworkingofthermalimagingcameraand itsapplication	2

Text/Referencebooks:

- “Renewableenergypowerfor sustainablefuture”,oxforduniversitypress.
- S.PSukhatmeand J.KNayak “Solarenergy,principleofthermalcollectionand storage”
- S.Kalogirou“Solarenergyengineering:processesandsystems”ISBN978-0-374501-9

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

- CO1:Tounderstandworkingofsolar radiationmeasuringequipments.
- CO2:Determine magnitudeofincidentradiation.
- CO3:Analyzeperformanceofvarioussolar collectorsystems.
- CO4:Applytheirknowledgetodesignimprovedsolarenergybasedsystems.

- CO5:Designandanalysesworkingofspaceheatingandcoolingsystems.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO4,PO5,PSO1
CO4	PO3,PSO1
CO5	PO3/PSO1

BME E0186 PROJECT BASED SOLAR ENERGY LAB

CREDITS: 02 **L–T–P-J: 0–0–0-8**

Objective: To train and guide students for modeling, design and fabrication of projects based on solar energy harvesting and applications in rural and industrial sector.

1. Role of nano fluid as a heat transfer fluid in thermal energy storage using phase change materials.(Like MWCNT)
2. Experimental investigation on thermal performance of heat pipe.
3. Experimental photovoltaic thermal training system domestic type.
4. Thermal energy storage via parabolic trough collector in high melting point temp. PCM.(like fatty acids)
5. Design and fabrication of flat plate solar collector and investigate the overall efficiency.
6. Design and fabrication of parabolic trough collector and investigate the overall efficiency.
7. Design and fabrication of solar air heater and analysis on efficiency.
8. Determine the performance of parabolic trough collector with fixed parameters and proper insulation of storage tank.
9. Design and fabrication of solar dryer and investigate efficiency.
10. Design and analysis of PV/T Solar air space heating system.

***Text/Reference books*:**

- “Renewable energy power for sustainable future”, oxford university press.
- “S.P. Sukhatme and J.K. Nayak “Solar energy, principle of thermal collection and storage”
- S. Kalogirou “Solar energyengineering:processesandsystems”ISBN978-0-374501-9

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome:

- CO1: Apply acquired knowledge in design of basic solar energy apparatus.
- CO2: Apply knowledge of basic sciences, heat and mass transfer, thermodynamics in analysis of solar apparatus.
- CO3: Analyze performance of various solar collector systems.
- CO4: Apply their knowledge to design improved solar energy based systems.
- CO5: Integrate/apply solar systems for applications in space heating and cooling requirement.
- CO6:Provide solution to rural and urban people regarding energy saving and utilization

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO4,PO5,PSO1
CO4	PO3,PSO1
CO5	PO3/PSO1
CO6	PO6/PSO1

BMEE_________: ALTERNATIVE FUELS AND POLLUTIONCONTROL

Objective: *The purpose of this course is to impart adequate knowledge on Alternative fuels and pollution control in the Automobiles.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**INTRODUCTION:** Various pollutants from SI and CI engines. Effects of pollutants on environment and human beings. Estimation of petroleum reserves. Need for alternative fuels. Potential alternative fuels (alcohols, oxygenates, hydrogen, LPG, NG, biogas, and vegetable oils), Merits and demerits of various alternative fuels. **EMISSIONS FROM SI ENGINES AND THEIR CONTROL:**Emission formation in SI engines (CO, HC and NOx). Effect of design and operating variables on emission formation. Control techniques -Thermal reactor, exhaust gas recirculation, three way catalytic convertor and Charcoal canister control for evaporative emission- positive crank case ventilation for blow by gas control. **EMISSIONS FROM CI ENGINES AND THEIR CONTROL:** Emission formation in CI engines (HC, CO, NOx, aldehydes, smoke and particulates), effect of design and operating variables on emission formation, control techniques, exhaust gas recirculation, NOx selective catalytic reduction, diesel oxidation catalytic convertor, diesel particulate filter, NOx versus particulates –trade off.	20
II	**EMISSION MEASURING INSTRUMENTS AND TEST PROCEDURES:** Principle of operation of emission measuring instruments used in SI and CI engines, Measurement of CO2 and CO by NDIR, hydrocarbon emission by FID, Chemiluminescent analyzer for NOx, Liquid and Gas chromatograph, spot sampling and continuous indication type smoke meters. **ALCOHOL FUELS AND GASEOUS FUELS:** Properties of alcohols, engine modifications required to use alcohols in SI engines, performance, combustion and emission characteristics in SI engines, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, use of alcohols in CI engines-emulsions, dual fuel system, spark assisted diesel engine, surface ignition engine, ignition accelerators, performance, combustion and emission characteristics in CI engines. Properties of hydrogen, production and storage methods, safety precautions , use in SI and CI engines, biogas production and its properties, use in SI and CI engines, properties of LPG and CNG, use in SI and CI engines. Performance, combustion and emission characteristics of hydrogen, biogas, LPG and	24

	CNG in SIand CI engines.	

Text Book:

- Ganesan V, *"Internal combustion engines"*, 4th edition, Tata McGraw Hill
- Michael F. Hordeski, *"Alternative Fuels: The Future of Hydrogen"*, The
- Rajput R. K, *"A textbook of Internal Combustion Engines"*, 2nd edition, Laxmi Publications (P) Ltd, 2007.
- Thipse S. S, *"Alternative Fuels: Concepts, Technologies and Developments",* Jaico Publishing House, 2010.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: At the end of the course, a student will be able to

CO1. Different types of Alternative fuels for Automobiles.
CO2. *Performance of Alternative Fuels used in Automobiles.*
CO3. Mechanism of pollutant formation in engines.
CO4.Treatment and control Techniques
CO5. Emission from CI and SI engines.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	POs/PSOs
CO1	PO1, PO3, PO6, / PSO1
CO2	PO1, PO3, PO6 / PSO1
CO3	PO2, PO3, PO4, / PSO1, PSO2
CO4	PO2, PO3, PO4, / PSO1
CO5	PO1, PO3, PO6, / PSO1, PSO2

BMEE 0101: ADVANCED FLUID MECHANICS

Objective: *Aims to give Mechanical Engineering students a deeper and more thorough grounding in principle sand basic applications of fluid mechanics. Topics include: review of the conservation principles; constitutive relations of Newtonian fluid; Navier-Stokes equation; inviscid flow – inertial properties of vortex, 2D potential flows; viscous flow–basic laminar flows, boundary layer theories; introduction toturbulent flow –flow separation, sources of drag.*

Credits:04 **L–T–P:3–1–0**

Module No.	Content	Teaching Hours
I	**Basic Concepts and Fundamentals:** Definition and properties of Fluids,Fluid as continuum, Langragian and Eulerian description, Velocity and stressfield, Fluidstatics,FluidKinematics **GoverningEquationofFluid Motion:**Reynoldstransporttheorem,Integral and differential forms of governing equations: mass, momentum andenergyconservationequations,Navier-Stokesequations,Euler'sequation,Bernoulli'sEquation. **Exact Solution of Navier – Stokes Equation:** Couette flows, Poiseuilleflows,Fullydevelopedflowsinnoncircularcross-sections,Unsteadyflows,Creepingflows. **Potential Flows:** Revisitof fluidkinematics,Stream andVelocitypotentialfunction, Circulation, Irrotational vortex, Basic plane potential flows: Uniformstream;SourceandSink;Vortexflow,Doublet,Superposition ofbasicplane potential flows, Flow past a circular cylinder, Magnus effect; Kutta-Joukowski lifttheorem;Conceptof liftanddrag.	20
II	**LaminarBoundaryLayer:**Boundarylayerequations,Boundarylayerthickness, Boundary layer on a flat plate, similarity solutions, Integral form ofboundarylayerequations,ApproximateMethods,Flowseparation,Entryflowintoaduct. **Turbulent Flow:** General equations of turbulent flow, Turbulent boundarylayer equation, Flat plate turbulent boundary layer, Turbulent pipe flow, Prandtlmixinghypothesis,Turbulencemodeling,Freeturbulentflows. **Compressible Flow:** Speed of sound and Mach number, Basic equations foronedimensionalflows,Isentropicrelations,Normal-shockwave,RankineHugoniotrelations,FannoandRayleighcurve,Machwaves,Obliqueshockwave, Prandtl-	21

	Meyerexpansionwaves,Quasionedimensionalflows,Compressibleviscousflows,Compressibleboundarylayers.	

Text Books:

- Gupta Vijay and Gupta S.K., “Fluid Mechanics and its Applications”, Wiley Eastern Ltd,1984.
- Som,S.K.&BiswasG.,“Introductionoffluidmechanics&FluidMachines”,TMH,2000,2ndEdition
- Shames, I.H., “Mechanics of Fluids”, Mc Graw Hill, Int. Student, Education, 2016
- FrankM.White,Viscous Fluid Flow, Third Edition, McGraw-Hill Series of Mechanical Engineering, 2006

Reference Books:

- Fox W. Robert, McDonald T. Alan, Introduction to Fluid Mechanics, Fourth Edition, JohnWiley&Sons,1995
- Muralidhar K. and Biswas G., Advanced Engineering Fluid Mechanics, Second Edition, Narosa,2005.
- Schlichting H., Boundary Layer Theory, SpringerVerlag,2000.
- Mc Cormack, P.S. & Crane, L.J. Physical Fluid Dynamics, AcademicPress,1973

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: *On learning this subject, students will be able to:*

- *CO1: Apply the fundamentals of kinematics, dynamics and conservation laws of fluid flow systems.*
- *CO2: Apply the principles of high and low Reynolds number flows to fluid flow systems.*
- *CO3: Review the concepts of boundary layer and flow in transition.*
- *CO4: Apply the fundamentals of turbulent flow to various fluid flow systems.*
- *CO5: Apply the fundamentals of one-dimensional isentropic flow to variable area duct.*
- *CO6: Analyse the concept of normal shock formation and its effects.*
- *CO7:Apply the principles of compressible flow to constant area duct subjected to friction or heat transfer*

Mapping of Course Outcomes (COs) with Program out comes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2,PO3/PS1
CO2	PO1,PO2,PO3/PS1
CO3	PO1,PO2/PS1
CO4	PO1,PO2,PO3/PS1
CO5	PO1,PO2/PS1
CO6	PO1,PO2,PO12/PS1
CO7	PO1,PO2,PO12/PS1

BMEE________: AUTOMOTIVE AERODYNAMICS

Objective: *At the end of the course, the students will be able to apply basic principles of aerodynamics for the design of vehicle body.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**INTRODUCTION**: Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics. **AERODYNAMIC DRAG OF CARS**: Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles. **SHAPE OPTIMIZATION OF CARS**: Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners. Case studies on modern vehicles.	22
II	**VEHICLE HANDLING**: The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles and racing cars. **WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS**: Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods. CFD analysis.	20

Text Book:

- Hucho .W.H., "Aerodynamic of Road Vehicles", Butterworths Co., Ltd., 1997
- A. Pope, "Wind Tunnel Testing", 2nd Edition, John Wiley & Sons New York, 1974.
- "Automotive Aerodynamic", Update SP-706, Society of Automotive Engineers Inc,1987.
- "Vehicle Aerodynamics", SP-1145, Society of Automotive Engineers Inc ,1996.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

***Course Outcome:* At the end of the course, a student will be able to**
CO1. To understand the fundamentals of aerodynamics.
CO2. To understand vehicle body optimization.

CO3. To acquire skill of measuring aerodynamics forces.
CO4. To develop skill of design of shape of cars.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	**POs/ PSOs**
CO1	PO1, PO2/ PSO1
CO2	PO1, PO3/ PSO1
CO3	PO1, PO2/ PSO1
CO3	PO1, PO2, PO3/ PSO1

BME E0105: COMPUTATIONAL FLUID DYNAMICS

Objective: *The objective of CFD is to model the continuous fluids with Partial Differential Equations (PDEs) and discretize PDEs into an algebra problem (Taylor series), solve it, validate it and achieves imulation based design.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** What is CFD, How Does A CFD Code Work, Applications of CFD and Problem Solving With CFD. Classification of Physical Behavior, The Role of Characteristics in Hyperbolic Equations, Classification Method for Simple Partial Differential Equation, Classification of Fluid Flow Equations, Auxiliary Conditions for Viscous Fluid Flow Equation. **Conservation Laws of Fluid Motion and Boundary Conditions:** Stress tensor over a control volume, Eienstein Indecies, Kronwer Delta Concept, Governing Equations of Fluid Flow, Equation of State, Continuity equation in Cartesian coordinate, polar coordinate and spherical coordinate system, Navier – Stokes Equations for A Newtonian Fluid, Conservative Form of the Governing Equations for Fluid Flow, Differential and Integral Forms of the General Transport Equation, Applications of Navier Stokes equation of motion-Flow through pipe, flow between two parallel plates etc. **Turbulent Flow:** Turbulence, types of turbulence, continuity equation for turbulent flow. Navier stokes equation for turbulent flow. Reynolds stress tensor for turbulent flow **Turbulence and Its Modeling** Turbulence Models Such as Boussinesque model, Mixing Length Model, application of mixing length model, Von-Karman turbulence model, application of Von-Karmanturbulencemodel,TheK–ƐModel,ReynoldsStressEquationModels.	20
II	**Potential Flow:** Source flow, Sink flow, Doublet, flow past a half body, flow over cylinder, pressure distribution. **The Finite Volume Method for Diffusion Problem:** Introduction, Finite Volume Method for Steady State Diffusion, Worked Examples: One Dimensional Steady State Diffusion, **TheFiniteVolumeMethodforConvection–DiffusionProblem:**Introduction, Steady One Dimensional Convection and Diffusion, The Central Differencing Scheme, Properties of Discretisation Scheme, The Upwind Differencing Scheme, The Hybrid Differencing Scheme, Properties of discretisation scheme.	20

Text Books:

- Anderson J., "*ComputationalFluidDynamicsAnIntroduction*",IIIEdition,Springer,2009.

Reference Books:

- Zikonav Oleg, *"Essential Computational Fluid Dynamics*", John Wiley & Sons,2010.
- Blazek J., "*Computational Fluid Dynamics: Principles and Applications*", II Edition, 2009, Elsevier Ltd.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Students are expected to learn:*

Course Outcomes On completion of this course, the students will be able to

CO1. Understand the Mathematical application used in CFD tools and techniques for effective designs of structured grid.

CO2. Apply modeling techniques to all the fluid dynamics, solid dynamics problems with respect to Multi-Disciplinary Industry.

CO3. Classify various computational methods for grid generation and its importance of efficient grid.

CO4. Formulate unstructured grid using various methods by considering different boundary conditions.

CO5.Simulate simple CFD models and analyze its results.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	*POs/PSOs*
CO1	*PO1,PO3,PO5/ PSO1,PSO3*
CO2	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO3	*PO1,PO2,PO3,PO4/ PSO1,PSO2,PSO3*
CO4	*PO1,PO2,PO3,PO5/ PSO1,PSO2,PSO3*
CO5	*PO1,PO3,PO5/ PSO1,PSO2,PSO3*

BMEE 0203 FINITE ELEMENT METHODS

Pre-requisite: *Continuum Mechanics*

Course objective: *The objective of this course is to teach in a unified manner the fundamentalsofthefiniteelementmethodfortheanalysisofengineeringproblemsarisinginsolids, structuresandsomebasicthermalengineering.Thecoursewillemphasizethesolutionofreal life problems using the finite element method underscoring the importance of the choice of the proper mathematical model, discretization techniques and element selection criteria. Finally, students will learn how to judge the quality of the numerical solution and improve accuracy in an efficient manner by optimal selection of solution variables.*

Credits:04 **L–T–P:3-1-0**

Module No.	Contents	Teaching Hours
1	**Introduction:** Finite element method as a numerical tool for design, Basic concepts, Formulation procedures, Historical development. **Line Elements and Applications:** Structural Problems: Linear and Quadratic elements, 1D Bar element, Formulation of Truss element, Plane truss, Euler–Bernoulli beam element formulation. Thermal and Fluid Problems: Steady state heat transfer: Element formulations, treatment to boundary conditions with application to 1-Dheatconduction,heattransferthroughthinfins;Potentialflowproblems **2D Elements**: Triangular (CST, LST): Shape function, Jacobian matrix,strain-displacementmatrix,stress-strainrelationshipmatrix,forcevector. Quadrilateral Elements(Q4,Q8):Shape function, Jacobianmatrix, strain-displacementmatrix,stress-strainrelationshipmatrix,forcevector.	20
2	**Application to Field Problems**: Thermal problems, Torsion of Noncircular shafts, Plane stress, plane strain and axisymmetric problems – Bodyforcesandtemperatureeffects,Stresscalculations,Plateandshellelements **DynamicProblems:**Formulationofdynamicproblems,consistentandlumped massmatrices for1-D and2-Delement, Solutionofeigenvalue1-Dproblems-Longitudinalandtransversevibrationofbeamswithallpossibleboundary conditions:Transformationmethods,Jacobimethod,VectorIterationmethods, subspaceiterationmethod.Solutionto1DtransientHeattransferproblems.	20

Text Books:

- T. R. Chandrupatla, Finite Element Analysis for Engineering and Technology, UniversityPress,2018
- P.Seshu,TextBookofFiniteElementAnalysis,PHILearningPvt.Ltd.,2012J. N. Reddy, An Introduction to the Finite Element Method, McGraw Hill InternationalEdition,2005

Reference Books:

- S.S.Rao,TheFiniteElementMethodinEngineering,ButterworthHeinemann,2017
- K.J.Bathe,FiniteElementProceduresinEngineeringAnalysis,PrenticeHallofIndia,2007
- O.C.Zienkiewics,R.L.Taylor,TheFiniteElementMethod,VolI&II,McGrawHill,1967

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome:

- *CO1:Understand the basic theory of finite-elementmethod.*
- CO2:*To understand the use of the basic finite elements for structural applications using truss, beam, frame.*
- CO3: *Understand the role and significance of shape function s in finite element formulations and use linear,quadratic, and cubic shape functions for interpolation.*
- CO4: *Understand the formulation of one-dimensional, two dimensional and three dimensional elements.*
- CO5: *Recognize sources of errors in FEA.*
- CO6: *to develop the ability to generate the governing FE equations for systems governed by partial differential equations*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO1/PSO1
CO3	PO1,PO2/PSO1
CO4	PO1/PSO1
CO5	PO5/PSO1
CO6	PO2,PO3/PSO1

BMEE0204VIBRATION AND NOISE

Pre-requisite: *Dynamics of Machine*

Objective: *The objective of this course is to have a clear understanding of vibrationsandmodellingofmechanicalsystems.Studentswillanalysefreeandforcedvibrationsandwilldevelop mathematical techniques to model and design mechanical systems.*

Credits:04 **L–T–P:3-1-0**

Module No.	Contents	Teaching Hours
I	**Introduction:** FreeandForcedVibrationsofSingleDegreeofFreedomSystem, Newton's Second Law, D'Alembert's Principle, Lagrange'sEquation, Types of Damping, Algorithmic Decrement, Equivalent ViscousDamping,Support Excitation. **Basic Vibration Control:** reduction at source, Active feedback control,VibrationIsolationandTransmissibility. Two Degree of Freedom Systems: Free and Forced Vibrations With andWithoutDamping,PrincipleandNormalModes,VibrationAbsorbers. **Multi Degree of Freedom Systems:** Various Methods of Analysis of MultiDegreeFreedomSystems,InfluenceCoefficients,CouplingofModes,Rayleigh'sMethod, Dunkerley's Equation,Holzer'sMethod.	22
II	**VibrationofContinuousSystems:**WaveEquation,LongitudinalVibrationof Bars, LateralVibrationsof Beam. **PassiveVibrationControl:**Basics,designofabsorber,absorberwithidealspring,shockabsorber,isolators withstiffnessanddamping. **ActiveVibrationControl:**Basics,Piezoelectricmaterials,electrorheologicalfluids,magnetorheologicalfluids,Magneto-andElectro-strictiveMaterialsin vibrationControl. **VibrationMeasurement:**Basics,dataacquisition,IntroductiontoCondition Monitoringof Machinery,FFT analysisandfilters.	20

Text Books:

- G.K. Grover, "Mechanical Vibrations": NemChandandBros,2009.
- S.S.Rao,"MechanicalVibrations",AddisonWesleyPublishingCompany,1990.
- S.G.Kelly,"MechanicalVibrations,Schaum'sOutlines",TataMcGrawHill, 2008.

Reference Books:

- J.S.rao,"VibrationConditionMonitoringofMachines":TataMc-GrawHill,2006.
- D.J. Inman, "Vibration and Control":JohnWilley&SonsInc,2002.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *After studying this subject student will be able to:*

- **CO1:**Analyze the mathematical modeling of the two degrees of feedom systems and explain about the working principle of vibration absorber.
- **CO2:** Compute the natural frequencies and mode shapes of amulti degree of freedom system and explain the modal analysis of a vibrating system.
- **CO3:** Ability to use Lagrange's equations for linear and nonlinear vibratory systems.
- **CO4:** Understood the parameter sand variables of a vibrating system.
- **CO5:** Understood the concept of natural frequency and how to find it for a vibrating system.
- **CO6:** Learn the process of vibration measurements and control.

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2/PSO3
CO2	PO1,PO2/PSO3
CO3	PO1,PO2/PSO3
CO4	PO1,PO2/PSO3
CO5	PO1,PO3/PSO3
CO6	PO1/PSO3

BMEE________: OFF-ROAD VEHICLES

Objective: *The purpose of this course is to impart adequate knowledge on off-road vehicles*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**INTRODUCTION TO OFF ROAD VEHICLES:** Land clearing machines Earth moving machines Scrapers and graders Shovels and ditchers Power plants, chassis and transmission, multi axle vehicles. **DIFFERENT TYPES OF EQUIPMENT:** Transport equipment: Powered equipment, Tractors and Trollies, Trailers, Platform lift trucks, Fork lift trucks, containers and Supports. Hauling equipment: Types of dump trucks, On-high way vehicles, off high way vehicles. Hoisting equipment: Jacks, truck mounted crane, Crawler crane, Outriggers. **TRACTORS:** Tractors and tractors units; Tractors in earth moving ,applications of tractors, Rating of Tractors, Wheeled and Crawler tractor, Recent trends in tractor design, power shift transmission and final drive in caterpillar tractor. Motor grader, recent trends, control mechanism of a caterpillar motor grader.	20
II	**EARTH MOVING MACHINES**: Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, scrapers, drag and self-Powered types - dump trucks and dumpers - loaders, single bucket, multi bucket and rotary types - power and Capacity of earth moving machines. **SCARPER AND GRADERS**: Scrapers, elevating graders, self-powered scrapers and graders. Shovels and Ditchers: Power shovel, revolving and stripper shovels - drag lines - ditchers - capacity of shovels. Land clearing machines: Bush cutter, stampers, tree dozer, rippers. **SHOVELS AND DITCHERS**: Power shovel, revolving and stripper shovels - drag lines - ditchers - Capacity of shovels.	22

Text Book:

- Abrosimov.K. Bran berg. A. and Katayer. K., Road m aking Machinery, MIR Publishers, Moscow, 1971.
- Wang. J.T., Theory of Grand vehicles, John Wiley & Sons, New York, 1987
- Off the road Wheeled and combined traction devices – Ashgate Publishing Co. Ltd. 1988.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: At the end of the course, a student will be able to

CO1. To understand the different off road vehicles and their usage..

CO2. *To understand the different types of equipment used in offroad vehicles.*

CO3. To understand the complete working of tractors.

CO4.To understand the complete working earth moving equipment.

CO5. To understand the complete working of scrappers and graders and shovels and ditchers.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	POs/PSOs
CO1	PO1, PO3, / PSO1
CO2	PO1, PO3, PO6 / PSO1
CO3	PO2, PO3/ PSO1, PSO2
CO4	PO2, PO3, PO4, / PSO1
CO5	PO1, PO3, / PSO1, PSO2

BMEE________: DESIGN OF TRANSMISSION SYSTEMS

Objective: *To learn about the design procedures for mechanical power transmission components.*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Flexible transmission elements-** design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets **Gear transmission-** speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears. **Straight bevel gear-** tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pairof helical gears.	22
II	**Gear box-** geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications. **Cam design, types**: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.	20

Text Book:

- Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
- Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
- Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: At the end of the course, a student will be able to

CO1. To design transmission systems for engines and machines.

CO2. *To understand Flexible Transmission-speed ratio*

CO3. To acquire skill of Gear analysis

CO4. To develop skill of design of gearbox and Cam.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	**POs/PSOs**
CO1	PO1, PO3, PO6, PO12/ PSO1
CO2	PO1, PO3, PO4, PO6, PO10/ PSO1
CO3	PO2, PO3, PO4, PO6/ PSO1
CO4	PO2, PO3, PO4, PO6/ PSO1

AUTOMOTIVE SAFETY
(B. TECH. (AUTOMOBILE ENGG.))

Credits: 03 **Semester: VIII** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**INTRODUCTION:** Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction. **SAFETY CONCEPTS:** Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.	20
II	**SAFETY EQUIPMENTS:** Seat belt, regulations, automatic seat belt tightened system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety **COLLISION WARNING AND AVOIDANCE:** Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions. **COMFORT AND CONVENIENCE SYSTEM:** Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system.	25

Text Book:

- Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011.
- Powloski. J., "Vehicle Body Engineering", Business books limited, London, 1969.
- Ronald.K.Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc., 1999.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: ***At the end of the course, a student will be able to***

CO1. Understand the functioning of various systems that enhances vehicle safety, passenger comfort. ***(Understand)***
CO2. *Explain various collision warning and avoidance system for an automobile.* ***(Understand)***
CO3 Explain various safety concepts required for a vehicle. ***(Understand)***
*CO4 Describe the mechanism for various comfort and convenience system like central locking system, rain sensor system etc. of a vehicle****(Understand)***

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :

COs	POs/PSOs
CO1	PO1, PO3, PO6, PO12/ PSO1
CO2	PO1, PO3, PO4, PO6, PO10/ PSO1
CO3	PO2, PO3, PO4, PO6/ PSO1
CO4	PO2, PO3, PO4, PO6/ PSO1

BMEG – 0900: PRODUCT DESIGN & DEVELOMENT

Prerequisites: *The knowledge of engineering drawing and to understand, ability to read technical drawing.*

Objectives: *To learn the sketcher workbench, part modeling and designing, wireframe and Surfacing for designing, assembly designing, &Drafting workbench.*

Credits: 05 **L-T-P: 5:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Part Modeling -** Introductions to 3D Experience Software, File Management, Rotate, Zoom, Fit, Refresh, Delete, Undo, Redo Shaded View, Wire frame, Toolbar, sketching tool- line, profile, arc, centerline, Rectangle, Spline, Ellipse, Conics, Trim, Fillet, symmetry, Offset, Break, Create & Modify Dimension, Fix, Horizontal, Vertical, Parallel, Perpendicular, coincidence, symmetric, Tangent, Collinear, concentric. Pad, Pocket, Edge Fillet, variable Radius Fillet, Tritangent Fillet, Face-Face Fillet, Chamfer, Edit Parameter, Edit Sketch, Delete, Isolate, Multi Pocket, MultiPad, Shaft, Groove, Hole Creating Points, Reference Lines, Reference, Planes,Rib, Slot, Stiffener, Combined Solid, Multisection Solid, and Multisection cut Models, Draft Shell, Thickness, Thread, Mirror, Scaling, Translate Bodies, Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, and User Pattern.	25
II	**Wireframe &Surface Design -** Circle, Splines, Helix, Corner, Connect Curve, Projection, and Intersection .Extrude, Revolved, Spherical, Cylindrical, Offset, Fill, Swept, Loft, Blend, Join, Split, Trim, Healing, Untrim, Disassemble, Boundary, Extract, Split, Thick Surface, Closed Surface, Sew. **Assembly -** Snap, Smart Move, Constraining,Joints- Pin, Prismatic, Cylindrical. **Drafting:**Generations of views, Auxiliary View, Sections view, Detail view , Partial View, Brocken view, Create Dimension, Create note, Generating Layouts	25

Outcomes: *After studying these topics, the student will be able to*

- To give shape to the idea, concept design and controlling the geometrical shape of the designedcomponent.
- To create 3D model of the design concept, understanding the part designing requirements that fulfil the design needs of various modules like CAE, CAM, CMM, Tool Designing, Drafting, 3D Printing.
- To understand, create, and control the complex shape geometries. To design & develop a newproduct from the existing one.
- To design assemblies, mechanism for validation.
- To understand the industrial drafting standards and generating industrial drawing.

Text Books:

- Catia v5 design fundamentals: a step by step guide by JaecheolKoh.

Reference Books:

- *CATIA V5-6R2015 Basics: Sketcher Workbench, Part Modeling, Assembly Design, Drafting, Sheet Metal Design, and Surface Design,Create Space Independent Publishing Platform (September 13, 2015)*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the basic commands of sketcher Workbench.
2. Understand and analysis the part modeling and designing in CATIA.
3. Describe the various methods to learn wireframe and Surfacing for designing.
4. Develop the various part of assembly design and learn the respective commands.
5. Describe the various methods to learn Drafting workbench.
6. Develop the various part of conceptual designing and learn the respective commands.

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO6, PO7/ PSO1
CO3	PO1,PO7/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEG – 0901: PRODUCT DESIGN & MANUFACTURING

Prerequisites: *The knowledge of manufacturing & design processes. To understand, ability to read technical drawing and part modelling*

Objectives: *To learn parametric modelling, mechanism design & simulation, Sheetmetal Model Fundamentals, Creating Primary and secondary Sheetmetal Wall Features, Bending and Unbending Sheetmetal Models, Form features and modifying sheet metal models, the process of Sheetmetal Setup and Tools and Detail sheet metal design & Computer Aided Manufacturing*

Credits: 05 **L-T-P: 5:0:0**

Modul eNo.	Content s	Teachin g Hours (Approx.)
I	**Parametric Modeling:** Introduction to parametric modeling, declaring user defined parameter, integrating user defined parameters with designed model, applyingrelation with parameters, Defining the law using algebraic equations, Creating design table using current parameters, Importing the existing design table, Mirror, Scaling, Translate Bodies. Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, User Pattern. **Sheet metal Design:** Sheet metal Model Fundamentals, Creating Primary Sheet metal Wall Features, Creating Secondary Sheet metal Wall Features, Bending and Unbending Sheet Metal Models, Sheet metal Form Features, Modifying Sheet Metal Models, Sheet metal Setup and Tools, Detail sheet metal designs.	30
II	**Manufacturing:** Manufacturing Process Overview, Creating Manufacturing Models, Configuring Operations, Using Reference Models, Using Work Piece Models, Creating and Using NC Model Assemblies, Creating and Configuring a Work Center, Creating and Configuring Tools, Using Manufacturing Parameters. **NC Sequencing:** Creating Face Milling Sequences, Creating Volume Milling Sequences, Creating Profile Milling Sequences, Creating Straight Cut Surface Milling Sequences, Advanced Surface Milling Options, Creating Roughing and Re-roughing Sequences, Creating Finishing Sequences, Creating Hole making Sequences, Using the Process Manager, Creating and Post-Processing CL Data Files.	20

Outcomes: *After studying these topics, the student will be able to*

- To design components with user defined parameters, formulas and algebraic expressions
- To design mechanism for motion and interference analysis
- Demonstrate various press working operations for mass production of sheet metal parts
- This enables to understand the mechanism behind the effective designing and modifying of themodels.
- Prepare working drawings and setup for economic production of sheet metal components
- It enables to understand various machining Processes and creating NC Sequences for turning.

Text Books:

- Advanced CATIA V5 Workbook: Knowledge ware , by Richard Cozzens
- Computer Numerical Control Programming Basics by Steve Krar Arthur Gill

Reference Books:

- Manufacturing Technology - Vol. 1 by PN Rao
- Manufacturing Technology - Vol. 2 by PN Rao

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the basic commands to learn the advance part modeling.
2. Analyze and understand the advance wire frame and surfacing
3. Develop the various to learn parametric modeling
4. Describe the various methods to learn Computer Aided Manufacturing (CAM)
5. Understand the basic commands to learn integrated design and Manufacturing
6. Understand the basic commands to learn CNC Programming and Machining

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEE – 0900: PRODUCT DESIGN & DEVELOMENT

Prerequisites: *The knowledge of engineering drawing and to understand, ability to read technical drawing.*

Objectives: *To learn the sketcher workbench, part modeling and designing, wireframe and Surfacing for designing, assembly designing, &Drafting workbench.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Part Modeling -** Introductions to 3D Experience Software, File Management, Rotate, Zoom, Fit, Refresh, Delete, Undo, Redo Shaded View, Wire frame, Toolbar, sketching tool- line, profile, arc, centerline, Rectangle, Spline, Ellipse, Conics, Trim, Fillet, symmetry, Offset, Break, Create & Modify Dimension, Fix, Horizontal, Vertical, Parallel, Perpendicular, coincidence, symmetric, Tangent, Collinear, concentric. Pad, Pocket, Edge Fillet, variable Radius Fillet, Tritangent Fillet, Face-Face Fillet, Chamfer, Edit Parameter, Edit Sketch, Delete, Isolate, Multi Pocket, MultiPad, Shaft, Groove, Hole Creating Points, Reference Lines, Reference, Planes, Rib, Slot, Stiffener, Combined Solid, Multisection Solid, and Multisection cut Models, Draft Shell, Thickness, Thread, Mirror, Scaling, Translate Bodies, Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, and User Pattern.	25
II	**Wireframe &Surface Design -** Circle, Splines, Helix, Corner, Connect Curve, Projection, and Intersection .Extrude, Revolved, Spherical, Cylindrical, Offset, Fill, Swept, Loft, Blend, Join, Split, Trim, Healing, Untrim, Disassemble, Boundary, Extract, Split, Thick Surface, Closed Surface, Sew. **Assembly -** Snap, Smart Move, Constraining,Joints- Pin, Prismatic, Cylindrical. **Drafting:**Generations of views, Auxiliary View, Sections view, Detail view , Partial View, Brocken view, Create Dimension, Create note, Generating Layouts	25

Outcomes: *After studying these topics, the student will be able to*

- To give shape to the idea, concept design and controlling the geometrical shape of the designedcomponent.
- To create 3D model of the design concept, understanding the part designing requirements that fulfil the design needs of various modules like CAE, CAM, CMM, Tool Designing, Drafting, 3D Printing.
- To understand, create, and control the complex shape geometries. To design & develop a newproduct from the existing one.
- To design assemblies, mechanism for validation.
- To understand the industrial drafting standards and generating industrial drawing.

Text Books:

- Catia v5 design fundamentals: a step by step guide by JaecheolKoh.

Reference Books:

- *CATIA V5-6R2015 Basics: Sketcher Workbench, Part Modeling, Assembly Design, Drafting, Sheet Metal Design, and Surface Design,Create Space Independent Publishing Platform (September 13, 2015)*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the basic commands of sketcher Workbench.
2. Understand and analysis the part modeling and designing in CATIA.
3. Describe the various methods to learn wireframe and Surfacing for designing.
4. Develop the various part of assembly design and learn the respective commands.
5. Describe the various methods to learn Drafting workbench.
6. Develop the various part of conceptual designing and learn the respective commands.

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO6, PO7/ PSO1
CO3	PO1,PO7/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEE – 0901: PRODUCT DESIGN & MANUFACTURING

Prerequisites: *The knowledge of manufacturing & design processes. To understand, ability to read technical drawing and part modelling*

Objectives: *To learn parametric modelling, mechanism design & simulation, Sheet metal Model Fundamentals, Creating Primary and secondary Sheetmetal Wall Features, Bending and Unbending Sheet metal Models, Form features and modifying sheet metal models, the process of Sheet metal Setup and Tools and Detail sheet metal design & Computer Aided Manufacturing*

Credits: 04 **L-T-P: 4:0:0**

Modul eNo.	**Content s**	**Teachin g Hours** (Approx.)
I	**Parametric Modeling:** Introduction to parametric modeling, declaring user defined parameter, integrating user defined parameters with designed model, applying relation with parameters, Defining the law using algebraic equations, Creating design table using current parameters, Importing the existing design table, Mirror, Scaling, Translate Bodies. Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, User Pattern. **Sheet metal Design:** Sheet metal Model Fundamentals, Creating Primary Sheet metal Wall Features, Creating Secondary Sheet metal Wall Features, Bending and Unbending Sheet Metal Models, Sheet metal Form Features, Modifying Sheet Metal Models, Sheet metal Setup and Tools, Detail sheet metal designs.	30
II	**Manufacturing:** Manufacturing Process Overview, Creating Manufacturing Models, Configuring Operations, Using Reference Models, Using Work Piece Models, Creating and Using NC Model Assemblies, Creating and Configuring a Work Center, Creating and Configuring Tools, Using Manufacturing Parameters. **NC Sequencing:** Creating Face Milling Sequences, Creating Volume Milling Sequences, Creating Profile Milling Sequences, Creating Straight Cut Surface Milling Sequences, Advanced Surface Milling Options, Creating Roughing and Re-roughing Sequences, Creating Finishing Sequences, Creating Hole making Sequences, Using the Process Manager, Creating and Post-Processing CL Data Files.	20

Outcomes: *After studying these topics, the student will be able to*

- To design components with user defined parameters, formulas and algebraic expressions
- To design mechanism for motion and interference analysis
- Demonstrate various press working operations for mass production of sheet metal parts
- This enables to understand the mechanism behind the effective designing and modifying of themodels.
- Prepare working drawings and setup for economic production of sheet metal components
- It enables to understand various machining Processes and creating NC Sequences for turning.

Text Books:

- Advanced CATIA V5 Workbook: Knowledge ware , by Richard Cozzens
- Computer Numerical Control Programming Basics by Steve Krar Arthur Gill

Reference Books:

- Manufacturing Technology - Vol. 1 by PN Rao
- Manufacturing Technology - Vol. 2 by PN Rao

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the basic commands to learn the advance part modeling.
2. Analyze and understand the advance wire frame and surfacing
3. Develop the various to learn parametric modeling
4. Describe the various methods to learn Computer Aided Manufacturing (CAM)
5. Understand the basic commands to learn integrated design and Manufacturing
6. Understand the basic commands to learn CNC Programming and Machining

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEE – 0902 : INJECTION MOLD DESIGN - I

Prerequisites: *The knowledge of molding and casting parameters and nomenclatures.*

Objectives: *To learn the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters, validate the design of mold design setup, analyzing part design for best gate location and analysis of mold flow, the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Injection Mold Design:** Plastic part design requirements and guidelines, Introduction to plastics material, Introduction to thermoplastic molding processes, Plastic part design principles - design for manufacturing, Design for Assembly, Introduction to mold design, Types of molds based on construction, Molding Undercuts-Part Ejection, Mold Venting.	25
II	Design of Feed system, Mold Cooling, Types of molds based on runner system, Mold Shrinkage, Mold Metals. **Mold Design - Core, Cavity:** Basic Mold Process, Prepare design models for the mold process	25

Outcomes: *After studying these topics, the student will be able to*

- This enables the students to demonstrate mold making process as well as to work on differenttypes of molds.
- Will be capable to design various injection molding set up components like core, cavity etc.
- Understanding & Interpreting results and molding parameters. Also Troubleshooting moldingproblems.
- This enables the students to demonstrate mold making process as well as to work on differenttypes of molds
- Will be capable to design various injection molding set up components like core, cavity etc.

Text Books :

- Injection Mold Design Engineering 8/31/07 Edition, by David Kazmer, Hanser Publications
- Fundamentals of Plastic Mold Design – 24 Jul 2012,by S. K. Nayak (Author), P.C. Padhi (Author),
  Y. Hidayatullah (Author)
- CATIA V5R20 for Designers – 6 Jan 2010,by Prof. Sham Tickoo Purdue Univ. (Author)

Reference Books:

- *Injection Molds for Beginners, by Rainer Dangel, Hanser Publications, Cincinnati*
- *The Complete Technology Book On Plastic Extrusion, Molding and Mold Designs Paperback – 2006,By Niir Board Of Consultants And Engineers (Author)*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the plastic part design requirements, mold design and its various aspects
2. Analyze the procedure of mold design.
3. Understand the various parameters of mold design.
4. To validate and analyze the design of mold design setup.
5. To do analysis of part design for best gate location and analysis of mold flow.
6. Understand the white light 3D Scanning process for data processing analysis and modeling.

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEE – 0903 : INJECTION MOLD DESIGN - II

Prerequisites: *The knowledge of molding and casting parameters and nomenclatures.*

Objectives: *To learn the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters, validate the design of mold design setup, analyzing part design for best gate location and analysis of mold flow, the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Design Model Analysis**: Mold Models, Shrinkage, Work pieces, Mold Volume Creation, Parting Lines, Skirt Surfaces, Parting Surface Creation, Splitting Mold Volumes, Mold Component Extraction, Mold Features Creation, Filling and Opening the Mold.	25
II	**Mold Analysis:** Introduction to Molded Part Analysis, Searching and specifying materials, Selecting Gate location, Analyzing part design for best gate location. Analyzing Molding window, Understanding Result advisor, Interpreting results and molding parameters, Troubleshooting molding problems.	25

Outcomes: *After studying these topics, the student will be able to*

- This enables the students to demonstrate mold making process as well as to work on differenttypes of molds.
- Will be capable to design various injection molding set up components like core, cavity etc.
- Understanding & Interpreting results and molding parameters. Also Troubleshooting moldingproblems.
- This enables the students to demonstrate mold making process as well as to work on differenttypes of molds
- Will be capable to design various injection molding set up components like core, cavity etc.

Text Books :

- Injection Mold Design Engineering 8/31/07 Edition, by David Kazmer, Hanser Publications
- Fundamentals of Plastic Mold Design – 24 Jul 2012,by S. K. Nayak (Author), P.C. Padhi (Author),
  Y. Hidayatullah (Author)
- CATIA V5R20 for Designers – 6 Jan 2010,by Prof. Sham Tickoo Purdue Univ. (Author)

Reference Books:

- *Injection Molds for Beginners, by Rainer Dangel, Hanser Publications, Cincinnati*
- *The Complete Technology Book On Plastic Extrusion, Molding and Mold Designs Paperback – 2006,By Niir Board Of Consultants And Engineers (Author)*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. Understand the plastic part design requirements, mold design and its various aspects
2. Analyze the procedure of mold design.
3. Understand the various parameters of mold design.
4. To validate and analyze the design of mold design setup.
5. To do analysis of part design for best gate location and analysis of mold flow.
6. Understand the white light 3D Scanning process for data processing analysis and modeling.

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1/ PSO1
CO5	PO1,PO5/ PSO2
CO6	PO1,PO5/ PSO2

BMEE – 0904: PRESS TOOL DESIGN

Prerequisites: *The knowledge of certain forging and forming processes.*

Objectives: *To learn product analysis, Design of Blanking, Piercing, Progressive and compound dies & introduction to Press Tool, Die sets, Guidelines for Design of Press Tools.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Product Analysis**: Introduction to Simulate, Theoretical Foundations, Structural Mechanics. Simulation Models, Explore materials and material properties, Understand and use structural constraints, Understand and use structural loads, Meshing, Understand convergence, Run structural analyses, Explore results, Refining the Design, Analyze assemblies with Simulate, Shells, Idealizations, Thermal Analysis.	25
II	**Press Tool Design:** Introduction to Presses and Auxiliary components, Classification based on Power Source, Press Frame, Actuation of Slides, No. of Slides in action, Sheet metal forming process, Force requirement for Blanking and Piercing, Introduction to Press Tool, Die sets. Design of Blanking, Piercing, Progressive and compound dies, Guidelines for Design of Press Tools, Center of Pressure in Un-symmetrically Profiled Components, Analysis of Press Tool, Design of Bending, drawing and forming dies.	25

Outcomes: *After studying these topics, the student will be able to*

- Able to formulate type analyses for various different analysis or optimization objectives
- Illustrate the principles and blank development in bent & drawn components
- Identify press tool requirements to build concepts pertaining to design of press tools

Text Books :

- *Lal, Jagdish, "Hydraulic Machines", Metropolitan Book Co. Pvt. Ltd.*
- *Rajput, R K, "Hydraulic Machines", S. Chand & co Ltd.*
- *Kumar, D. S., "Hydraulic Machines", Khanna Publishers*

Reference Books:

- *Press Tools Design and Construction by P H JOSHI (SheetMetal*)

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs:

1. To learn Sheet-metal model fundamentals, creating primary and secondary sheet-metal wallFeatures
2. To learn Bending and Unbending Sheet-metal Models, Form features and modifying sheet metalmodels.

3. To learn the process of Sheet-metal Setup and Tools and Detail sheet metal designs
4. Design of Blanking, Piercing, Progressive and compound dies.
5. Introduction to Press Tool, Die sets, Guidelines for Design of Press Tools
6. To learn rapid prototyping or additive manufacturing, RPT Data Processing, Data Post Processing, Solid based rapid manufacturing processes.

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1, PO7, PO6
CO5	PO1, PO7/ PSO1
CO6	PO1,PO5/ PSO2

BMEE – 0905: PRESS TOOL MANUFACTURING

Prerequisites: *The knowledge of engineering press tool design, pressing tools, processes and machines*

Objectives: *To make the students understand the concepts of prototyping with manufacturing by giving more emphasis to their applications in engineering.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Rapid Proto typing**: Introduction to Rapid Prototyping, Design for modularity, Data Preparation, FDM manufacturing processes, RPT Data Processing, Data Post Processing, 3D Printing.	20
II	**Press Tool Manufacturing:** 300 Ton Press Deep Draw Press, Co2 Welding Machine, Spot Welding Machine, Press Tool Machining, Press Component Manufacturing, Assembly	20

Outcomes: *After studying these topics, the student will be able to*

- Understand Partial differentiation and its applications
- Trace the curves given in Cartesian coordinates
- Determine the linear dependence of functions
- Find the inverse of a square nonsingular matrix by various methods
- Solve the ordinary differential eqns. of higher order and grasp their applications

Text Books :

- Lal, Jagdish, "Hydraulic Machines", Metropolitan Book Co. Pvt. Ltd.
- Rajput, R K, "Hydraulic Machines", S. Chand & co Ltd.
- Kumar, D. S., "Hydraulic Machines", Khanna Publishers

Reference Books:

- Press Tools Design and Construction by P H JOSHI (Sheet Metal)

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs:

1. Understand and learn Sheet-metal model fundamentals, creating primary and secondary sheet-metal wall Features
2. Analyze and learn Bending and Unbending Sheet-metal Models, Form features and modifyingsheet metal models.
3. Understand and learn the process of Sheet-metal Setup and Tools and Detail sheet metal designs
4. Student will able to design of Blanking, Piercing, Progressive and compound dies.
5. Introduction to Press Tool, Die sets, Guidelines for Design of Press Tools
6. Understand and learn to do rapid prototyping or additive manufacturing, RPT Data Processing,Data Post Processing, Solid based rapid manufacturing processes.

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1, PO7, PO6
CO5	PO1, PO7/ PSO1
CO6	PO1,PO5/ PSO2

BMEE – 0906: SMART MANUFACTURING

Prerequisites: *The knowledge of basic electronic engineering components circuits and C language.*

Objectives: *To learn the concepts of IOT, identify the different technology, different applications in IOT, different applications in IOT, different protocols used in IOT & Predictive Maintenance.*

Credits: 04 **L-T-P: 4:0:0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Basics of IOT:** What is IOT? Network Architecture, Device Architecture, What is Embedded? **Basic Hardware in IOT:** Basic Electronics Components of IOT, LED, Resistors, Capacitors, Transistors, Relay, Switch, Buzzer, LDR, Potentiometer, PIR, How to glow LED without program, LED by switch, LED by two switch. **Controller use in IOT:** What is Arduino & ESP8266? History of Arduino & ESP8266, Hardware and Software Description, Fundamentals, Basic Arduino Programs, Serial Monitor and Debugging Tool, Installing Board Packages, Installing Sensor Libraries, Interfacing Sensors.	25
II	**Tinker cad Simulation:** Basic Electronic Circuits, Arduino Simulation. **Augmented reality**: Introduction to AR, The Basics of AR functionality, Taking the next steps with ARCore, Bringing ARCore to life, Frameworks of Software Development Tools in VR. **IOT Communication Protocols:** Wireless Protocols (SPI, I2C, UART, USRT), Networking Protocols (OSI Reference Model, TCP/IP, Ethernet), Sending data to Thingsboard.io/Adafruit. **Preventive Maintenance:** Maintenance Method Selection, Function and components, Failure Modes,Maintenance method and essential care tasks. **Thingworx Composer:** Introduction to Thingworx, Creating Thing, Thing Template, Building Mashups, Creating Weather mashup	25

Outcomes: *After studying these topics, the student will be able to*

- Understand Partial differentiation and its applications
- Trace the curves given in Cartesian coordinates
- Determine the linear dependence of functions
- Find the inverse of a square nonsingular matrix by various methods
- Solve the ordinary differential eqns. of higher order and grasp their applications

Text Books:

- The Internet of Things (MIT Press Essential Knowledge series) ,by Samuel Greengard (Author)
- IOT (Internet of Things) Programming: A Simple and Fast Way of Learning IOT ,by David Etter (Author)

Reference Books:

- Arduino for Beginners: Step-by-Step Guide to Arduino, by Author Simon Knight
- Beginning c for Arduino, by Jack Purdam
- Things Worx third edition, by Gerardus Blokduk

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

COs

1. To learn the concepts of IOT and its application in Manufacturing Industry.
2. To learn different protocols used in IOT.
3. To learn about different sensors and its data collection in IoT platform.
4. To learn about different controllers in IoT and its use.
5. To learn ThingWorx IIoT platform and use it with real-time projects.
6. To learn about Predictive maintenance & asset monitoring using IoT.

COs	POs/ PSOs
CO1	PO1, PO7, PO6/ PSO1
CO2	PO1,PO7/ PSO1
CO3	PO1/ PSO1
CO4	PO1, PO7, PO6
CO5	PO1, PO7/ PSO1
CO6	PO1,PO5/ PSO2

COURSE STRUCTURE

M.TECH.

PRODUCTION/DESIGN ENGINEERING

Under

Choice Based Credit System (CBCS)

M.Tech. (Production Engg./Design Engg.)

Programme Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	MME C0002	Simulation, Modeling and Analysis	3	1	0	4	4
2	MME C0802	Simulation, Modeling and Analysis Lab	0	0	2	1	2
3	MME C0003	Advanced Production Technology	3	1	0	4	4
4	MME C0004	Finite Element Method (FEM)	3	1	0	4	4
5	MME C0804	Finite Element Method Lab (FEM)	0	0	2	1	2
6	MME C0005	Optimization for Engineering Design	3	1	0	4	4
7	MME C0006	Computer Aided Manufacturing (CAM)	3	1	0	4	4
8	MME C0007	Theory of Elasticity & Plasticity	3	1	0	4	4
9	MME C0008	Industrial Tribology	3	1	0	4	4

Programme Electives

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HR/WK
			L	T	P		
1	MME E0002	Machine Tool Design	3	1	0	4	4
2	MME E0004	Interfacial Tribology	3	1	0	4	4
3	MME E0005	Energy Conservation and Management	3	1	0	4	4
4	MME E0006	Industrial Automation and Robotics	3	1	0	4	4
5	MME E0007	Advanced Machining	3	1	0	4	4
6	MME E0008	Supply Chain Management	3	1	0	4	4
7	MME E0009	Design of Production Toolings	3	1	0	4	4
8	MME E0011	Rapid Prototyping and Tooling	3	1	0	4	4
9	MME E0012	Nanotechnology and its Applications	3	1	0	4	4
10	MME E0015	Reliability & Maintenance	3	1	0	4	4

11	MME E0016	Computer-Based Numerical Techniques and Soft Computing	3	1	0	4	4
12	MME E0017	Micro Manufacturing	3	1	0	4	4
13	MME E0018	Concurrent Engineering	3	1	0	4	4
14	MME E0019	Technology of Competitive Manufacturing	3	1	0	4	4

MME C0002 SIMULATION, MODELLING AND ANALYSIS

Objective: *The objective of the course is to teach methods and techniques for achieving an effective transformation from requirements and business drivers to technology and product design. The ability to create simulation models of various types. Provide basic knowledge of simulation system principles. Find conclusions from analysis of simulation results.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **Introduction:** A review of basic probability and statistics, random variables and their properties, Estimation of means variances and correlation. **Physical Modelling:** Concept of System and environment, Continuous and discrete systems, Linear and non-linear systems, Stochastic activities, Static and Dynamic models, Principles of modeling, Basic Simulation modeling, Role of simulation in model evaluation and studies, advantages of simulation **System Simulation:** Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages.	22
II	**Unit-II** **System Dynamics:** Growth and Decay models, Logistic curves, System dynamics diagrams. **Probability Concepts in Simulation:** Stochastic variables, discrete and continuous probability functions, Random numbers, Generation of Random numbers, Variance reduction techniques, Determination of length of simulation runs. **Simulation of Mechanical Systems:** Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic and pneumatic systems. **Simulation of Manufacturing Systems:** Simulation of waiting line systems, Job shop with material handling and Flexible manufacturing systems, Simulation software for manufacturing, Structure and development of expert systems.	23

Text Book:

- W. Bolton, "Mechatronics – Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd. 1868
- Ibrahim Zeid, "CAD/CAM Theory and Practice", Tata McGraw-Hill Publishing Company Limited. 1991
- Sankar Sengupta, System Simulation and modelling, Pearson. 2013

Reference Books:

- Deo, Narsingh, Millican Charles E.,"System Simulation With Digital Computer", PHI. 1978
- Gordon, Geoffrey, System Simulation, PHI. 1977
- P. Radhakrishnan, S Subramanyan, V. Raju, CAD/CAM/CIM, New Age International Publishers. 2008

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the student will be able to:*

- CO1: Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.

- CO2: Describe the role of important elements of discrete event simulation and modeling paradigm.
- CO3: Develop skills to apply simulation software to construct and execute goal-driven system models.
- CO4: *Understand the numerical methods involved in Finite Element Theory.*
- CO5:*Understand the role and significance of shape functions in finite element formulations and use linear, quadratic, and cubic shape functions for interpolation.*
- CO6:*Recognize sources of errors in FEA.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO3/PSO1
CO2	PO2/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1
CO6	PO5/PSO1

MME C0802 SIMULATION MODELLING & ANALYSIS LAB

Objective:

The objective of the lab is the ability to create simulation models of various types. Provide basic knowledge of simulation system principles and random number generators and probability distributions. Find conclusions from analysis of simulation results of real life problems.

List of Experiments

- To determine the value of Pi using Monte carlo simulations
- Simulation of random walk problem and its displacement analysis
- Simulation and analysis of exponential growth models, exponential decay and modified exponential growth models
- To plot the probability distribution of the sum of numbers on randomly thrown dices
- To draw an Ellipse, Parabola, Hyperbola and circle and their rotations
- Generation of random numbers & find the factorial of a user defined Pseudo number
- Swapping the values of two user defined random numbers
- To simulate and analyse the hermite curve, Bezier curve etc.
- Implementation of Bi section method in solving polynomials
- equation modelling and simulation using Newton- raphson method
- Introduction to simulink neural network simulations
- Implementation of fuzzy logics
- Introduction to Model Predictive controller
- Applications of MATLAB in the solution of differential equations and numeric integration of real life problems

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

- *CO1: understand what is a model, types of models, purpose of models*
- *CO2:be able to transform facts into an insightful model, to be used as input for requirements discussions and system design and verification*
- *CO3: be able to analyze the impact of changes; change and variation cases*
- *CO4: understand the value for: requirements, potential design issues, modeling inputs*
- *CO5: Demonstrate the ability to design a component using MATLAB.*
- *CO6: Understand the importance of analysis and design, using the MATLAB, in the broader context of engineering practice.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO3/PSO1
CO2	PO5/PSO1
CO3	PO5/PSO1
CO4	PO5/PSO1
CO5	PO1/PSO1
CO6	PO6/PSO1

MME C0003 ADVANCED PRODUCTION TECHNOLOGY

Objective: *To extend the knowledge of Production as input/output model, metal working and types of stresses finally upto crack formation in high speed machining.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-1** Production as input/output model, metal working and types of stresses, workability and crack formation. Yield criteria and flow rules, Von-misses and Tresca yield criteria, yield criteria for plane stress conditions. Stresses and strains, principal stresses, mean stress and stress deviator, strain rates and velocities, principal strain rates, equation of incompressibility, idealized stress and strain diagrams. High speed machining, frame work of machining system, primary & secondary shear zones, formation of hydrodynamic flow zone, shape and nature of flow zone, pressure and shear stress distribution due to presence of flow zone.	22
II	**Unit-2** Interfacial friction and lubrication mechanism in metal forming: coulmb's law, constant friction factor, composite friction, hydrodynamic friction, friction during high speed forming, lubrication mechanism and lubricants used in different forming processes. Analysis of drawing and extrusion under plain strain and axisymmetric conditions, maximum reduction, optimal cone angle and dead zone formation, forging and rolling of strips, , evaluation of roll force, roll torque and mill horse power, strip biting by rolls. Consideration of inertia forces during high speed forming. Slip line field and load bounding techniques and their applications. Recent development in forming technologies: explosive forming, orbital forging, continuous forming, cut extruder, roll extruder, water hammer forming, melt extraction processes. System of metal forming technology, micro/precision forming.	23

Text Books:

- G. W. Rowe, An Introduction to the Principles of Metal Working, Arnold
- B. Avitzur, Metal forming analysis, McGraw Hill

Reference Books:

- S. Kumar, Technology of Metal Forming Processes, Prentice Hall of India
- M. C. Shaw, Metal Cutting Principle, Tata-Mc Graw Hill

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: The course intends to expose the students to:
CO1: Understand the concept of production model, metal working and types of stresses.
CO2: Knowledge of high speed machining, frame work of machining system, primary and secondary shear zone, yield criteria and flow rules.
CO3: Understanding of knowledge of interfacial friction and lubrication mechanism in metal forming.
CO4: Knowledge and analysis of drawing and extrusion under plain strain and axis symmetric.
CO5: Understanding of precision machining concepts and their processes

CO6: Knowledge of recent development in various forming processes.

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PO3/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

MME C0004 FINITE ELEMENT METHOD (FEM)

Objective: *To provide the fundamental concepts of the theory of the finite element method. To teach students how to model and analyze mechanical systems using finite element analysis. To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code. To reinforce students' understanding of engineering through the analysis of real-world problems. To teach students the basic skills in using commercial finite element software and effective presentation of their analysis results.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational and Weighted residual approaches, Shape functions, Natural co-ordinate system, Element and Global stiffness matrices, Boundary conditions, Errors, Convergence and patch test, Higher order elements. Application to plane stress and plane strain problems, Axi-symmetric and 3D bodies, Plate bending problems with isotropic and anisotropic materials	22
II	**Unit-II** Structural stability, Other applications e.g., Heat conduction and fluid flow problems. Idealization of stiffness of beam elements in beam-slab problems, Applications of the method to materially non-linear problems, Organization of the Finite Element programmes, Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems, FEM an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis.	23

Text Books:

- O.C. Zienkiewicz and R.L. Taylor, The Finite Element Method, McGraw Hill, 1967
- J. N. Reddy, An Introduction to Finite Element Method, McGraw Hill, 2005
- K.J. Bathe, Finite Element Procedure in Engineering Analysis, McGraw Hill, 2007
- C.S. Krishnamoorthy, Finite Element Analysis, Tata McGraw Hill, 1994

Reference Books:

- T.R Chandragupta and A.D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall India, 2018
- O.C. Zenkiewicy & Morgan, Finite Element and Approximation, 2006

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the student will be able to:*

- CO1:*Understand the numerical methods involved in Finite Element Theory.*
- CO2:*to develop the ability to generate the governing FE equations for systems governed by partial differential equations*
- CO3:*to understand the use of the basic finite elements for structural applications using truss, beam, frame, and ...*
- CO4:*Understand the role and significance of shape functions in finite element formulations and use*

linear, quadratic, and cubic shape functions for interpolation.

- CO5:*Understand the formulation of one-dimensional, two dimensional and three dimensional elements.*
- CO6:*Recognize sources of errors in FEA.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1/PSO1
CO2	PO2/PSO1
CO3	PO6/PSO1
CO4	PO5/PSO1
CO5	PO5/PSO1
CO6	PO5/PSO1

MME C0804 FINITE ELEMENTS ANALYSIS LAB

OBJECTIVE: *The main objective of this lab is mentioned below:*

- *Understand formulations of matrix ALGEBRA using MATLAB*
- *Understand Gaussian elimination using MATLAB*
- *Understand formulating one dimensional problems using MATLAB*
- *Understand formulating two dimensional problem using MATLAB*
- *Understand the basics of solving beams and frame related problems USING MATLAB*
- *Understand the basic of solving heat transfer problems using MATLAB*

List of Experiments

- Basics of Matrix algebra using MATLAB. Tutorials on Solving matrix algebra and equations using MATLAB.
- Solving one dimensional problems (example bar problems under compressive ,shear and tensile loading) using MATLAB by considering element stiffness matrix and stress matrices.
- Solving truss related problems using MATLAB under compressive and tensile loading by considering element stiffness matrix and stress matrices.
- Solving axisymmetric problems using MATLAB under tensile and compressive loading by considering element stiffness matrix and stress matrices.
- Solving Cantilever beams related problems using MATLAB.
- Solving Simply supported beam problem using MATLAB.
- Solving various kinds of bending moment and shear force problems on beams and elastic beams using MATLAB.
- Solving problems on plane frames using MATLAB and its finite element formulation.
- Solving heat transfer related problems using MATLAB of bars and trusses (inclusion of temperature effects)
- Solution of three dimensional problems using MATLAB –stress and strain calculations.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

- *CO1: Understand the mathematical and physical principles underlying the Finite Element Method (FEM)as applied to solid mechanics, thermal analysis and fluid mechanics.*
- *CO2: Be able to create his/her own FEM computer programs, for simple problems, on MATLAB.*
- *CO3: Be able to analyze more complex problems (in solid mechanics or thermal analysis) using*
- *CO4: commercial FEM software such as ANSYS*
- *CO5: Demonstrate the ability to design a component using FEM analysis.*
- *CO6: Understand the importance of analysis and design, using the FEM, in the broader context of engineering practice.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1/PSO1
CO2	PO5/PSO1
CO3	PO5/PSO1
CO4	PO5/PSO1
CO5	PO3/PSO1
CO6	PO6/PSO1

MME C0005 OPTIMIZATION FOR ENGINEERING DESIGN

Objective: *The objective of optimization for engineering design to introduce the fundamental concepts of optimization techniques and to make the learners aware of the importance of optimizations in real scenarios to provide the concepts of various classical and modern methods for constrained and unconstrained problems in both single and multivariable.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **Introduction:** Historical Developments, Engineering applications of Optimization Classical Optimization Techniques: Introduction, Review of single and multivariable optimization methods with and without constraints, Non-linear one-dimensional minimization problems, Examples. Constrained Optimization Techniques: Introduction, Direct methods - Cutting plane method and Method of Feasible directions, Indirect methods - Convex programming problems, Exterior penalty function method. **Unconstrained Optimization Techniques:** Introduction, Direct search method - Random, Uni-variate and Pattern search methods, Rosenbrock's method of rotating co-ordinates, Descent methods - Steepest Decent methods-Quasi-Newton's and Variable metric methods.	22
II	**Unit-II** Geometric Programming: Introduction, Unconstrained minimization problems, solution of unconstrained problem from arithmetic, geometric inequality point of view, Constrained minimization problems, Generalized polynomial optimization, Applications of geometric problems, Introduction to stochastic optimization. **Novel methods for Optimization:** Introduction to simulated annealing, simulated annealing algorithm; Genetic Algorithm (GA), Design of GA, Key concepts of GA, Neural Networks, A frame work for Artificial Neural Network (ANN) models, Construction of Neural Network algorithm (Back propagation algorithm).	23

Text Books:
- S. S. Rao, Engineering Optimization, New Age International, 2000
- E. J. Haug and J.S. Arora, Applied Optimal Design, Wiley, New York,1981

Reference Books:
- Kalyanmoy Deb, Optimization for Engineering Design, Prentice Hall of India, 2012
- G.V. Reklaites, A. Ravindran and K.M. Rogsdeth, Engineering Optimization, Wiley, New York,1983

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the students will be able to:*
- CO1: *Formulate optimization problems.*
- CO2: *Understand and apply the concept of optimality criteria for various type of optimization problems.*
- CO3: *Solve various constrained and unconstrained problems in single variable as well as multivariable.*
- CO4: *Apply the methods of optimization in real life situation.*
- CO5: *To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.*

- CO6: *To implement different methods of optimization on the data obtained through machining process.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
CO1	PO3/PSO1
CO2	PO2/PSO1
CO3	PO5/PSO1
CO4	PO1/PSO1
CO5	PO1/PSO1
CO6	PO5/PSO1

MME C0006 COMPUTER AIDED MANUFACTURING (CAM)

Objective: *To develop an understanding between the CAD and CAM using interfaces for minimizing the waste and operation time which can be further useful in building the skills of new professionals visualization, simulation and optimization tools.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **CNC Machine Tools:** Development of CNC Technology-Principles and classification of CNC machines, Advantages & economic benefits, Digital and Analog output, CNC, DNC and Adaptive Control. **CNC Programming:** Co-ordinate System, APT programming, Manual part-programming-structure, G & M Codes, developing simple part programmes, Parametric programming, CAM packages for CNC machines, Part Programming & Dynamic simulation, Variant and Generative Process planning, Manufacturing Logic. **Tooling for CNC Machines:** Tooling system for machining centre, Tool holders, Tool magazines, ATC mechanisms, Tool management.	22
II	**Unit-II** **Robotics and Material Handling Systems:** Robotic technology, and applications, Robot anatomy, Basic Robot motion and Work Volume, Robotic work station design, Economic aspects of Robotization, Grippers and Censors, material handling function, Conveyer systems, Automated guided vehicle systems, Automated storage/retrieval systems, Robotized material handling, Material handling system selection. **Group Technology and Flexible Manufacturing System:** Part families, Parts classification and coding, Benefits of Group Technology, Flexible manufacturing systems-Introduction, FMS workstations, Planning for FMS, Applications and benefits. Computer Integrated Manufacturing: Introduction, Concept of integration and interfacing, Design aspects of CIM, MAP/TOP, Database requirements, Factories of future.	24

Text Books:

1. P. Radahkrishnan, Computer Numerical Control Machines, New Central Book Agency
2. M.S. Sehrawat and J.S. Narang, CNC Machines, Dhanpat Rai and Co.

Reference Books:

1. M.P. Groover, Automation, Production systems and Computer Integrated Manufacturing, Prentice Hall of India
2. Paul Ranky, Computer Integrated Manufacturing, Prentice Hall of India

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: After studying the subject, students will be able to:

CO1: Knowledge of NC, CNC, &DNC technology used in manufacturing system.

CO2: Understanding and implementation of NC, CNC, &DNC codes in processing machines.

CO3: Application of Adaptive control in CNC Manufacturing.

CO4: Knowledge about CIM, FMS and Robotic system along with their application areas with limitations.

CO5: Understanding for the necessity of using automation in Industries.
CO6: Knowledge of entire computer aided manufacturing concepts with implementation in industries.

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PO3/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

MME-0007 THEORY OF ELASTICITY & PLASTICITY

Pre-requisite: *Strength of Materials*

Objective: *To impart knowledge of Principal stresses and strains. To develop analytical skills of solving problems using plain stress and plain strain. To impart knowledge of engineering application of plasticity. To allow students become familiar with problem formulations and solutions in elasticity and plasticity; and prepare students for future study in advanced engineering mechanics.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **Elasticity and Plasticity Theories:** Analysis of stress and strain, equilibrium, Compatibility and constitutive equations, Plane stress and plane strain problems, General equation in Polar co-ordinates, Rotating discs and stresses in circular discs, Stress function in terms of harmonic and complex functions, Equation of equilibrium of a deformed body in curvilinear co-ordinates, Principle of superposition and principle of virtual work. Nature of engineering plasticity, Differential equations of equilibrium, 3D stress analysis, infinitesimal deformation, finite deformation, Von Mises', Tresca's and anisotropic yield criteria, halgh-Westergard stress space representation of yield criteria, experimental verification of yield criteria, Subsequent yield surfaces,	23
II	**Unit-II** Elastic and plastic stress-strain relations and stress strain rate equations, Prandtle-Reuaa equations, Generalized plastic stress strain relations, Anisotropy and instability. Torsion of thin tubes, Bending of cantilevers, Uniformly and continuous loaded beams, Bending of circular, elliptical and rectangular cross-section bars, Axi-symmetric formulation and deformation of solids of revolution. Plane plastic flow, Slip-line field theory, Application of slip line field theory to plane strain metal forming processes, Plane plastic stress and pseudo plane stress analysis and its applications, Extremum principle for rigid perfectly plastic material, surfaces of stress and velocity discontinuity, Upper bound and lower bound theorems and applications.	22

Text Books:

1. Lurie, A.I., "Theory of Elasticity" (Foundations of Engineering Mechanics)
2. Gladwell, G. M., "Contact Problems in the Classical Theory of Elasticity", Kluwer Aca

3. Chakrabarty, J., "Applied Plasticity", Springer-Verlog
4. Hill, R., "The Mathematical Theory of Plasticity", Oxford University.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:

Students are expected to learn:

On completion of this course, the students would be able to:

CO1. The student will be able to demonstrate the application of plane stress and plane strain in a given situation.

CO2. The student will be able to analyze the structure using plasticity.

CO3. The student will be able to have knowledge of stress-strain relations for linearly elastic solids, and Torsion.
CO4. The student will be able to apply different theorems to understand the problems and their solutions in solid mechanics.
CO5. The student will be able to have the capability to differentiate elastic and plastic behavior of different materials.

COs	POs	PSOs
CO1	PO1	PSO1
CO2	PO2	PSO1
CO3	PO1	PSO1
CO4	PO4	PSO1
CO5	PO3	PSO1

MME C0008 INDUSTRIAL TRIBOLOGY

Objective: *Tribology has a significant impact on life-cycle and production-cycle issues in all industrial sectors, through the implementation of novel materials and new technologies resulting in performances which up till now remained unachievable. Tribology is most concerned with improving the efficiency and reliability of machinery, production equipment and systems for manufacturing. Through the establishment of prolonged life-times and improved production efficiency it has a major impact on the reduction of raw materials consumption and generation of waste.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit I** Basic concepts, Definition and scope of tribology in engineering applications. Friction: Material properties influencing friction, Laws of friction, Causes/theories of friction, Friction vis-à-vis material, Types of friction, Elastic and visco-elastic effects in friction, Effects of friction. **Wear**: Causes/sources of wear, Types of wear (adhesive, abrasive, corrosive, erosive, fretting), Wear of polymers, Wear of ceramic materials, Effects of wear, Steps for wear prevention/resistance. **Lubrication:** Purpose of lubrication, Lubrication principles/types, Properties and characteristics of lubricants, Types of lubricants (oils, greases, solid lubricants), Lubrication systems, Hydraulic oils.	23
II	**Unit II** Behaviour of Tribological Components: Selection, friction, wear, failures and lubrication aspects of bearings (rolling contact & plain), gears, wire-ropes, seals, conveyors etc. Objective and monitoring strategies for machine diagnostics. Fluid-Film Bearings: Fundamentals of Viscous Flow, Reynolds Equation and Application, Thrust Bearings, Journal Bearings, Squeeze-Film Bearings, Hydrostatic Bearings, Hybrid Bearings	22

Text Books:

1. Harish Hirani, Fundamentals of Engineering Tribology with Applications, CAMBRIDGE University press,2016
2. Emad Omrani, Pradeep K. Rohatgi, Pradeep L. Menezes, Tribology and Applications of Self-Lubricating Materials, CRC Press,2018

Reference Books:

1. John A. Schey, Tribology in Metal Working, ASME, OMIO, 1983
2. Sushil Kumar Srivastava, Tribology in Industries, S.Chand, 2011
3. W.B. Rowe, Hydrostatic and Hybrid Bearing Design, Butterworths, 1st Edition 1983

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the students will be able to:*
CO1: Formulate tribology based problems.
CO2: Understand and apply the concept of tribology criteria for various type of industrial problems, including SME company problems.

CO3: To have a mastery of the friction/lubrication mechanisms and know how to apply them to the practical engineering problem.
CO4: To k*now the methods to reduce the friction for several mating surfaces.*
CO5: *To have a practical exposure on the fluid film bearing, applications of Reynold's Equation, Thrust Bearings, Journal Bearings, Squeeze-Film Bearings, Hydrostatic Bearings, Hybrid Bearings.*

Mapping of Course Outcome (COs) with program outcome and program specific outcomes

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO2/ PSO2
CO3	PO2/PSO3
CO4	PO3/PSO3
CO5	PO4/PSO3

MME E0002 MACHINE TOOL DESIGN

Objective: *To improve the knowledge to reduce the overall cost of manufacturing a product by producing acceptable parts at lowest cost and increase the production rate by designing tools that will produce parts as quickly as possible. Maintain quality by designing tools which will consistently produce parts with the required precision. Reduce the cost of special tooling by making every design as cost effective and efficient as possible. Design tools that will be safe and easy to operate*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Working and auxiliary motions in machine tools, hydraulic and mechanical transmission, transforming rotary motion into translatory motion, reversing and differential mechanisms, machine tool design process. Regulation of speed and feed rates, stepped and stepless regulations, classification and design of speed and feed boxes, structure diagram, speed chart and gearing diagram. Criteria and design requirements of machine tool structure, material selection, machine tool structure profiles, stiffness and compliance.	23
II	**Unit-II** Design procedure for beds, columns, housings and tables. Concept of dimension chain in design of machine tools. Design of guide ways; function and type of guide ways/slide ways, design criteria and material selection, Tribology of guide ways; design of spindle and spindle supports, stability analysis, dynamics of machine tools. Control systems and its functions for machine tools, requirement and selection of control systems, ergonomic considerations. Design aspects of conventional machine tools and case studies.	22

Text Books:

1. Mehta N.K., Machine Tool Design, Tata McGral Hill, Publishing Co., New Delhi
2. Basu S.K., Design of Machine Tools, Allied Publishers, New Delhi.
3. Koenisberger, F., Design of Metal Cutting Machine Tools, Pergamon Press, Oxford, U.K.

Reference Books:

1. Bhattacharya, A. & Sen, G.C., Principles of Machine Tools, New Central Book Agency, Kolkata.
2. Acherkan, N., Machine Tool Design, Vol- I-IV, Mir Publishers, Moscow.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: Upon successful completion of this course, the students will be able to:

CO1: Understand to apply cutting mechanics to metal machining based on cutting force and power consumption.

CO2: Design and selection of cutting tool materials and tool geometries for different metals.

CO3: Understanding of machine tool structures and machining economics.

CO4: To develop knowledge and importance of metal cutting parameters.

CO5: To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.

CO6: To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

COs	**POs/PSOs**
CO1	PO1/PSO2/PSO3
CO2	PO1/PO2/PO12/PSO3
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12/PSO3
CO5	PO1/PO3/PSO2/PSO3
CO6	PO1/PO2/PO12/PSO3

MME E0004 INTERFACIAL TRIBOLOGY

Objective: *Tribology has a significant impact on life-cycle and production-cycle issues in all industrial sectors, through the implementation of novel materials and new technologies resulting in performances which up till now remained unachievable. Tribology is most concerned with improving the efficiency and reliability of machinery, production equipment and systems for manufacturing. Through the establishment of prolonged life- times and improved production efficiency it has a major impact on the reduction of raw materials consumption and generation of waste. Raising public and industrial awareness as to the importance of tribology towards a sustainable growth of the industrial European society. The promotion of new materials and technologies to reduce friction and wear, raw material consumption and environmental loading in industrial processing. Promote standardization of characterization and test methods in the field of tribology.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit I** Basic concepts, Definition and scope of tribology in engineering applications. Work die interface, interaction between lubricant, workpiece and die, Hydrodynamic action at work-die interface. Interfacial friction: Mechanisms of friction applicable to forming processes, effect on pressure and die loads. W Wear; Definition, Classification, adhesive, abrasive, surface fatigue and corrosive & erosive wear, Cavitation and fretting wear. Lubrication in metal working: Different regimes of lubrication, attributes of a good lubricant, properties composition and characteristics.	23
II	**Unit II** Lubricants for industrial processes, e.g. rolling, forging, extrusion, sheet metal etc. Analysis of basic processes under different Tribological conditions, governing equations, yield criteria & flow rules, Reynold's equation. Analysis of pressure distribution & die loads for rolling, forging, wire drawings, extrusion. Hydrostatic extrusion, hydrodynamic wire drawing, water hammer forming, melt spin process.	22

Text Books:

1. J.A. Schey, Marcel Debber, Metal Deformation Processes, Friction and Lubrication, INC, New York
2. Surender Kumar, Technology of Forming Processes, Prentice Hall, 2008

Reference Books:

1. John A. Schey, Tribology in Metal Working, ASME, OMIO, 1983
2. Sushil Kumar Srivastava, Tribology in Industries, S.Chand, 2011
3. Theo mang, Kirsten bobzin and Thorsten bartels, Industrial Tribology, Wiley-VCH, 2010

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the students will be able to:CO1: Formulate tribology based problems.*
CO2: Understand and apply the concept of tribology criteria for various type of industrial problems, including SME company problems.
CO3: To have a mastery of the friction/lubrication mechanisms and know how to apply them to the practical engineering proble.

CO4: To k*now the methods to reduce the friction for engineering surface.*
CO5: *Tribology finds applications in all industrial sectors including the aerospace, automotive, engineering, construction, biomedical, textile, optical and microelectronics industries.*

Mapping of Course Outcome (COs) with program outcome and program specific outcomes

COs	**POs/PSOs**
CO1	PO1/PSO2
CO2	PO2/ PSO2
CO3	PO2/PSO3
CO4	PO3/PSO3
CO5	PO4/PSO3

MMEE 0005 ENERGY CONSERVATION AND MANAGEMENT

Objective:*The main objective of this course is to understand the principles associated with effective energy management and to apply these principles in the day-to-day life. To gain exposure to energy auditing, to identify energy conservation opportunities in various industrial processes and to evaluate the performance of boilers, furnaces and other energy intensive equipment/processes.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **INTRODUCTION:** Principles of energy management. Managerial organization, Functional areas for i)manufacturing industry, ii) Process industry, iii) Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating, Organizing and managing energy management programs **ENERGY AUDIT:** Definition and concepts. Types of energy audits, Basic energy concepts, Resources for plant energy studies. Data gathering, Analytical techniques. **Energy Conservation:** Technologies for energy conservation, Design for conservation of energy materials, Energy flow networks. Critical assessment of energy usage. Formulation of objectives and constrains, Synthesis of alternative options and technical analysis of options. Process integration.	23
II	**Unit-II** **ENERGY EFFICIENCY:** Fuels and Combustion-Boilers-Steam System-Furnaces - Insulation and Refractory -FBC Boilers -Cogeneration -Waste heat recovery, Diesel Generating System. **ENERGY PERFORMANCE ASSESSMENT:** Equipment and Utility systems - Boilers-Furnaces-Cogeneration, Turbines (Gas, Steam)- Heat Exchangers-Electric Motors and Variable Speed, Drives-Fans and Blowers-Water Pumps-Compressors. **ALTERNATIVE ENERGY SOURCES:** Solar energy: Types of devices for solar energy collections, Thermal storage system, Control systems. Wind Energy, Availability, Wind Devices, Wind Characteristics, performance of turbines and systems. Waste Minimization and Resource Conservation.	22

Text Books:

- H.Koontz and CyrillDonnel"Management" McGraw Hill
- S.C.Kuchhal"Financial Management" Chaitanya Publishing House.

Reference Books:

- W. C., Turner and S. Doty "Energy Management Hand Book" Fairmont Press, 2009, 7th edition.
- C.B Smith "Energy Management Principles" Pergamon Press, 2007
- W.R Murphy"Energy Management" Elsevier, 2007.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*
Outcome:

- *CO1: Understanding of energy conservation and identification of energy conservation, opportunities in various industrial processes.*
- *CO2: Knowledge of various tools and components energy auditing.*
- *CO3: Ability to evaluate the performance of industrial boilers, furnaces etc. by direct and indirect methods.*
- *CO4: to investigate cogeneration in industry and waste heat recovery techniques and devices.*

- *CO5: To conduct energy audits in domestic and small industries.*
- *CO6: Apply knowledge to develop model and prototypes which can recover waste heat for energy efficiency.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/PSOs**
CO1	PO1,PO2, PSO1
CO2	PO1, PO3, PSO1
CO3	PO4,PO5, PSO1
CO4	PO4, PO5,PSO1
CO5	PO4,PO5,PO6,PSO1
CO6	PO4,PO5,PO6,PO7, PSO1,PSO2

MME E-0006 INDUSTRIAL AUTOMATION AND ROBOTICS

Objective: *Introduction to the concept of industrial automation, scope of automation and study of socio-economic effects. Introduction to AGV, MAP/TOP, AS/RS. Introduction of Robots and robotics technology, Robot kinematics, Robot vision, Image representation. Robots applications in various areas and its capabilities, Robot maintenance and its Safety, Robot education etc.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Automation:** Mechanization and automation, Types of automation, Automation strategies, Hard Automation and Soft Automation, Economics of automation, Socio economic aspects of automation. Manufacturing Automation: Classification and types of Manufacturing Automation, Scenario of Automation and Factory Configuration, Shop Floor Control, MAP/TOP, AS/RS. AGV- Components Functions and Benefits, Traffic Controls and Safety, Cost Justification and Applications. **Robotics:** Robotic technology and applications, Laws of robotics, Robot systems and anatomy, Robot classification, Physical Configuration and Work Volume, Functional Parameters: Revolution, Accuracy and Repeatability, End Effectors, Robotic grippers, Design considerations, Classification of Grippers, Advantages & disadvantages, Industrial Applications and uses etc.	22
II	**Robot Mechanism:** Robot kinematics, Homogeneous transformation, Direct and inverse kinematics, Robotic Motions: Manipulator motions, Robot drives, actuators and control, Robot motion and path planning control and Controllers, Robotic sensors and Robot vision, Image representation, Image recognition approaches. **Robot Applications:** Robot Capabilities, Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference, Economics and social aspects of robotics, Future applications. Implementation Principles, Maintenance & Safety, Robotic Education.	23

Text Books:

1. Groover, Automation, Production System & Computer Integrated Manufacturing, Prentice Hall India
2. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, Robotics, McGraw Hill.

Reference Books:

1. J.J. Craig, Robotics, Addison-Wesely
2. R.D. Klafter, t.a. Chmielewski and M. Negin, Robot Engineering: An Integrated Approach, Prentice Hall India.
3. Matthew t. mason, Mechanics of robotic manipulation, Prentice hall of India, 2005
4. Kumar Surender, "Industrial Robots and Computer Integrated Manufacturing", Oxford & IBH Publishing Co., New Delhi.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: *Upon* successful completion of this course, students would be able to:

CO1: *Knowledge regarding key components and functioning of an automated industry;*

CO2: *Knowledge regarding the working of elements such as hydraulic generator, hydraulic & pneumatic actuator hydraulic & pneumatic valves used in heavy construction equipments;*

CO3: *Knowledge regarding the methods used to handle the materials in automated industry, such as AGV's;*

CO4: *Basic knowledge about the Robotics and its technology, Robotics Laws, Classification, Functional*

Parameters;

CO5: *Knowledge about the work volume and physical configuration of various Robots;*

CO6: Knowledge regarding the, its vision system, its kinematics, Robot drives and ultimately the applications in various areas.

	POs	PSOs
CO1	PO1	PSO2
CO2	PO1, PO3	PSO2
CO3	PO1	PSO3
CO4	PO1	PSO2
CO5	PO1	PSO2
CO6	PO1, PO3	PSO2

MME E0007 ADVANCED MACHINING

Objective: *This course provides thorough knowledge of fundamental principle and application of these non-conventional machining processes. Course deal with different non-conventional machining process like AJM,USM,AFF,MAF,WJC,AWJM,EDM,LBM, PAM,EBM ,ECM,ECG CHM etc.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	Abrasive Jet Machining (AJM) Ultrasonic Machining (USM) Abrasive Finishing Processes (a) Abrasive Flow Finishing (AFF) (b) Magnetic Abrasive Finishing (MAF) Water Jet Cutting (WJC) Abrasive Water Jet Machining (AWJM) Electric Discharge Machining/Grinding/Cutting (a) Electric Discharge Machining (EDM) (b) Electric Discharge Grinding and Electric Discharge Diamond Grinding (c) Wire Electric Discharge Machining	23
II	Laser Beam Machining (LBM) Plasma Arc Machining (PAM) Electron Beam Machining (EBM) Electrochemical Machining (ECM) Electrochemical Grinding (ECG) Electrostream Drilling (ESD) Electrochemical Deburring (ECDE) Shapedtube Electrolytic Machining (STEM) Chemical Machining (CHM) Anode Shape Prediction and Tool Design For ECM Processes	22

Text Books:

1. V.K. Jain, “Advanced Machining Processes”: Allied Publishers, 2008.
2. Hassan abdel-gawad el-hofy, “Advanced Machining Processes”: McGraw Hill Professional, 2005.

Reference Books:

1. James Brown, “Advanced Machining Technology Handbook”, McGraw-Hill, 1998.
2. Wit grzesik, “Advanced machining processes of metallic materials”: Elsevier, UK, 2008.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: **After completion of the course, student will be able to:**

CO1: Explaining the detail of types of Advance machining processes.

CO2: Evaluate the need of Advance machining processes.

CO3: Identifying the correct manufacturing processes by determining the appropriate advance machining process for complex geometries.

CO4: Explain principle and applications of advanced machining processes.

CO5: Knowledge will also be implemented for research work in the field of advance manufacturing field.

CO6: Identify the background behind the development of unconventional machining processes.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

COs	**POs/PSOs**
CO1	**PO1 / PSO2**
CO2	**PO1, PO2, PO3 / PSO2**
CO3	**PO5 / PSO2**
CO4	**PO5, PO6 / PSO2**
CO5	**PO9, PO10, PO12 / PSO**
CO6	**PO4, PO5, PO12 / PSO2**

MME E0008 SUPPLY CHAIN MANAGEMENT

Objective: *Supply chain management is concerned with the efficient integration of suppliers, factories, warehouses and stores so that merchandise is produced and distributed: – In the right quantities – To the right locations – At the right time. In order to – Minimize total system cost – Satisfy customer service requirements –- face global competition –Improve standardization.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Role of Supply Chain Management, Scope and Importance:** Historical evolution of SCM, Supply Chain components: Inbound logistics, Operations, Outbound logistics, Forecasting, Inventory strategy, Transportation Strategy, Warehouse management. Information Strategy for SCM **Customer driver Strategies:** Logistics and Competitive Strategy, System View, Co-ordination and Management of Transportation, Inventory, Order Processing, Purchasing, Warehousing, Materials Handling, Packaging.	23
II	**Customer Service Management.** Marketing and Supply Chain Interface, finance and supply Chain Interface. Distribution Policies and Plans.**Decision Support Models of Supply Chain Management:** Transportation Systems. Warehouse Design, Distribution Policies, Transshipment. Etc. Information Systems. Role of Information Technology in SCM, Performance measurement, Organization design and structure for effective supply chain.	22

Text Books:

- Sunil Chopra, Peter Meindl and D.V. Kalara, Supply Chain Management, Strategy, Planning and Operation, Pearson Education Inc, 2007.
- Ronald H. Ballou, Business Logistics Management, Prentice Hall,1984
- R. P. Mohanty, S.G. Deshmukh, Supply chain Management(Theories & Practices), 2005

Reference Books:

- B. S. Sahay, Emerging issues in supply chain management, Macmillan, India. 2004

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: After completion of course, the student will be able to:

- CO1: Develop a sound understanding of the important role of supply chain management in today's business environment
- CO2:Become familiar with current supply chain management trends Understand and apply the current supply chain theories, practices and concepts utilizing case problems and problem-based learning situations
- CO3:Learn to use and apply computer-based supply chain optimization tools including the use of selected state of the art supply chain software suites currently used in business
- CO4:Develop and utilize critical management skills such as negotiating, working effectively within a diverse business environment, ethical decision making and use of information technology
- CO5:Demonstrate the use of effective written and oral communications, critical thinking, team building and presentation skills as applied to business problems
- CO6:Successfully complete a case project concluding with a written and oral presentation of the

findings

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1/PSO3
CO2	PO2/PSO2, PSO3
CO3	PO5/PSO3
CO4	PO8/PSO3
CO5	PO4/PSO3
CO6	PO3, PO4/PSO3

MME E0009 DESIGN OF PRODUCTION TOOLINGS

Objective: *Introduction to the concept of Jig and Fixtures, Types and applications, principle of design and constructions, Location and Clamping, Design of turning, milling, drilling & indexing, Hydraulic, Pneumatic and Pneumo-hydraulic devices for Jigs and Fixtures. Concept of press work, Punch and die clearance, Centre of pressure with calculation of blank diameter. Introduction of Dies for metal powder performs, design considerations, Basic models of flow & perform design. Concept of design of various types of tools for production of holes, surface of revolution and flat surface. Materials for cutting tools, cutting dies and forming dies. Introduction of Economics of Tooling and special features of Plastic as a tooling material.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit I** **Jigs & Fixtures:** Types and applications. Principle of design and constructions, Location and clamping. Design of turning, Milling, Drilling & Indexing Jigs and fixtures. Hydraulic, Pneumatic and pneumo-hydraulic devices for jigs and fixtures. **Cutting Tools:** Design of tools for the production of holes, surfaces of revolution, and flat surfaces like single point tools, form tools, drills, milling cutters. Materials for cutting tools, cutting dies and forming dies, Economics of Tooling. Plastics as a tooling material.	23
II	**Unit II** **Press Dies:** Classification of dies, components of dies assembly, Simple dies, compound dies, combination dies and progressive dies. Punch and die clearance, centre of pressure, and calculation of blank diameter. Design of cutting dies, forming dies and progressive dies. Dies for metal powder performs, design considerations, Basic models of flow & preform design.	22

Text Books:

1. Umesh Chandra & Surender Kumar, Production Engineering Design (Tool Design), Satya Prakashan, New Delhi
2. C. Donaldson G.H.Lecain and V.C.Goold, Tool Design, Tata McGraw Hill

Reference Books:

3. Osterguard E, Basic Die Making, Mc-Graw Hill Book Co
4. V.Arshinov, Metal Cutting & Tool Design, Mir Publication
5. Kortesoja, Victor A., Properties and Selection of Tool Material, ASM

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: *Upon* successful completion of this course, students would be able to:

CO1: The course intends to expose the students to the concept of Jig and Fixtures their principle of design and constructions with Locating and clamping.
CO2: Awareness of Hydraulic, Pneumatic and Pneumo-hydraulic devices used for Jig and Fixtures
CO3: Knowledge of Press Dies, classification, components of die assembly,
CO4: Dies for metal powder performs, design consideration.
CO5: Awareness the knowledge of cutting Tools, Design of tools for the production of holes, surface of Revaluation.
CO6: Able to know the materials for cutting tools, cutting dies and forming dies and plastic as a tooling material.

	POs	PSOs
CO1	PO1, PO3	
CO2	PO1	
CO3	PO1	
CO4	PO1, PO3	
CO5	PO1	
CO6	PO1, PO3	

CO4: To k*now the methods to reduce the friction for engineering surface.*
CO5: *Tribology finds applications in all industrial sectors including the aerospace, automotive, engineering, construction, biomedical, textile, optical and microelectronics industries.*

Mapping of Course Outcome (COs) with program outcome and program specific outcomes

COs	**POs/PSOs**
CO1	PO1/PSO2
CO2	PO2/ PSO2
CO3	PO2/PSO3
CO4	PO3/PSO3
CO5	PO4/PSO3

MMEE 0005 ENERGY CONSERVATION AND MANAGEMENT

Objective: *The main objective of this course is to understand the principles associated with effective energy management and to apply these principles in the day-to-day life. To gain exposure to energy auditing, to identify energy conservation opportunities in various industrial processes and to evaluate the performance of boilers, furnaces and other energy intensive equipment/processes.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **INTRODUCTION:** Principles of energy management. Managerial organization, Functional areas for i)manufacturing industry, ii) Process industry, iii) Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating, Organizing and managing energy management programs **ENERGY AUDIT:** Definition and concepts. Types of energy audits, Basic energy concepts, Resources for plant energy studies. Data gathering, Analytical techniques. **Energy Conservation:** Technologies for energy conservation, Design for conservation of energy materials, Energy flow networks. Critical assessment of energy usage. Formulation of objectives and constrains, Synthesis of alternative options and technical analysis of options. Process integration.	23
II	**Unit-II** **ENERGY EFFICIENCY:** Fuels and Combustion-Boilers-Steam System-Furnaces - Insulation and Refractory -FBC Boilers -Cogeneration -Waste heat recovery, Diesel Generating System. **ENERGY PERFORMANCE ASSESSMENT:** Equipment and Utility systems - Boilers-Furnaces-Cogeneration, Turbines (Gas, Steam)- Heat Exchangers-Electric Motors and Variable Speed, Drives-Fans and Blowers-Water Pumps-Compressors. **ALTERNATIVE ENERGY SOURCES:** Solar energy: Types of devices for solar energy collections, Thermal storage system, Control systems. Wind Energy, Availability, Wind Devices, Wind Characteristics, performance of turbines and systems. Waste Minimization and Resource Conservation.	22

Text Books:

- H.Koontz and CyrillDonnel"Management" McGraw Hill
- S.C.Kuchhal"Financial Management" Chaitanya Publishing House.

Reference Books:

- W. C., Turner and S. Doty "Energy Management Hand Book" Fairmont Press, 2009, 7th edition.
- C.B Smith "Energy Management Principles" Pergamon Press, 2007
- W.R Murphy"Energy Management" Elsevier, 2007.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

- *CO1: Understanding of energy conservation and identification of energy conservation, opportunities in various industrial processes.*
- *CO2: Knowledge of various tools and components energy auditing.*
- *CO3: Ability to evaluate the performance of industrial boilers, furnaces etc. by direct and indirect methods.*
- *CO4: to investigate cogeneration in industry and waste heat recovery techniques and devices.*

- *CO5: To conduct energy audits in domestic and small industries.*
- *CO6: Apply knowledge to develop model and prototypes which can recover waste heat for energy efficiency.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1,PO2, PSO1
CO2	PO1, PO3, PSO1
CO3	PO4,PO5, PSO1
CO4	PO4, PO5,PSO1
CO5	PO4,PO5,PO6,PSO1
CO6	PO4,PO5,PO6,PO7, PSO1,PSO2

MME E-0006 INDUSTRIAL AUTOMATION AND ROBOTICS

Objective: *Introduction to the concept of industrial automation, scope of automation and study of socio-economic effects. Introduction to AGV, MAP/TOP, AS/RS. Introduction of Robots and robotics technology, Robot kinematics, Robot vision, Image representation. Robots applications in various areas and its capabilities, Robot maintenance and its Safety, Robot education etc.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Automation:** Mechanization and automation, Types of automation, Automation strategies, Hard Automation and Soft Automation, Economics of automation, Socio economic aspects of automation. Manufacturing Automation: Classification and types of Manufacturing Automation, Scenario of Automation and Factory Configuration, Shop Floor Control, MAP/TOP, AS/RS. AGV- Components Functions and Benefits, Traffic Controls and Safety, Cost Justification and Applications. **Robotics:** Robotic technology and applications, Laws of robotics, Robot systems and anatomy, Robot classification, Physical Configuration and Work Volume, Functional Parameters: Revolution, Accuracy and Repeatability, End Effectors, Robotic grippers, Design considerations, Classification of Grippers, Advantages & disadvantages, Industrial Applications and uses etc.	22
II	**Robot Mechanism:** Robot kinematics, Homogeneous transformation, Direct and inverse kinematics, Robotic Motions: Manipulator motions, Robot drives, actuators and control, Robot motion and path planning control and Controllers, Robotic sensors and Robot vision, Image representation, Image recognition approaches. **Robot Applications:** Robot Capabilities, Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference, Economics and social aspects of robotics, Future applications. Implementation Principles, Maintenance & Safety, Robotic Education.	23

Text Books:

3. Groover, Automation, Production System & Computer Integrated Manufacturing, Prentice Hall India
4. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, Robotics, McGraw Hill.

Reference Books:

5. J.J. Craig, Robotics, Addison-Wesely
6. R.D. Klafter, t.a. Chmielewski and M. Negin, Robot Engineering: An Integrated Approach, Prentice Hall India.
7. Matthew t. mason, Mechanics of robotic manipulation, Prentice hall of India, 2005
8. Kumar Surender, "Industrial Robots and Computer Integrated Manufacturing", Oxford & IBH Publishing Co., New Delhi.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: *Upon* successful completion of this course, students would be able to:

CO1: *Knowledge regarding key components and functioning of an automated industry;*

CO2: *Knowledge regarding the working of elements such as hydraulic generator, hydraulic & pneumatic actuator hydraulic & pneumatic valves used in heavy construction equipments;*

CO3: *Knowledge regarding the methods used to handle the materials in automated industry, such as AGV's;*

CO4: *Basic knowledge about the Robotics and its technology, Robotics Laws, Classification, Functional Parameters;*

CO5: *Knowledge about the work volume and physical configuration of various Robots;*

CO6: Knowledge regarding the, its vision system, its kinematics, Robot drives and ultimately the applications in various areas.

	POs	PSOs
CO1	PO1	PSO2
CO2	PO1, PO3	PSO2
CO3	PO1	PSO3
CO4	PO1	PSO2
CO5	PO1	PSO2
CO6	PO1, PO3	PSO2

MME E0007 ADVANCED MACHINING

Objective: *This course provides thorough knowledge of fundamental principle and application of these non-conventional machining processes. Course deal with different non-conventional machining process like AJM,USM,AFF,MAF,WJC,AWJM,EDM,LBM, PAM,EBM ,ECM,ECG CHM etc.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	Abrasive Jet Machining (AJM) Ultrasonic Machining (USM) Abrasive Finishing Processes (c) Abrasive Flow Finishing (AFF) (d) Magnetic Abrasive Finishing (MAF) Water Jet Cutting (WJC) Abrasive Water Jet Machining (AWJM) Electric Discharge Machining/Grinding/Cutting (d) Electric Discharge Machining (EDM) (e) Electric Discharge Grinding and Electric Discharge Diamond Grinding (f) Wire Electric Discharge Machining	23
II	Laser Beam Machining (LBM) Plasma Arc Machining (PAM) Electron Beam Machining (EBM) Electrochemical Machining (ECM) Electrochemical Grinding (ECG) Electrostream Drilling (ESD) Electrochemical Deburring (ECDE) Shapedtube Electrolytic Machining (STEM) Chemical Machining (CHM) Anode Shape Prediction and Tool Design For ECM Processes	22

Text Books:

1. V.K. Jain, “Advanced Machining Processes”: Allied Publishers, 2008.
2. Hassan abdel-gawad el-hofy, “Advanced Machining Processes”: McGraw Hill Professional, 2005.

Reference Books:

3. James Brown, “Advanced Machining Technology Handbook”, McGraw-Hill, 1998.
4. Wit grzesik, “Advanced machining processes of metallic materials”: Elsevier, UK, 2008.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcome: **After completion of the course, student will be able to:**
CO1: Explaining the detail of types of Advance machining processes.

CO2: Evaluate the need of Advance machining processes.

CO3: Identifying the correct manufacturing processes by determining the appropriate advance machining process for complex geometries.

CO4: Explain principle and applications of advanced machining processes.

CO5: Knowledge will also be implemented for research work in the field of advance manufacturing field.

CO6: Identify the background behind the development of unconventional machining processes.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

COs	**POs/PSOs**
CO1	**PO1 / PSO2**
CO2	**PO1, PO2, PO3 / PSO2**
CO3	**PO5 / PSO2**
CO4	**PO5, PO6 / PSO2**
CO5	**PO9, PO10, PO12 / PSO**
CO6	**PO4, PO5, PO12 / PSO2**

MME E0008 SUPPLY CHAIN MANAGEMENT

Objective: *Supply chain management is concerned with the efficient integration of suppliers, factories, warehouses and stores so that merchandise is produced and distributed: – In the right quantities – To the right locations – At the right time. In order to – Minimize total system cost – Satisfy customer service requirements –- face global competition –Improve standardization.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Role of Supply Chain Management, Scope and Importance:** Historical evolution of SCM, Supply Chain components: Inbound logistics, Operations, Outbound logistics, Forecasting, Inventory strategy, Transportation Strategy, Warehouse management. Information Strategy for SCM **Customer driver Strategies:** Logistics and Competitive Strategy, System View, Co-ordination and Management of Transportation, Inventory, Order Processing, Purchasing, Warehousing, Materials Handling, Packaging.	23
II	**Customer Service Management.** Marketing and Supply Chain Interface, finance and supply Chain Interface. Distribution Policies and Plans.**Decision Support Models of Supply Chain Management:** Transportation Systems. Warehouse Design, Distribution Policies, Transshipment. Etc. Information Systems. Role of Information Technology in SCM, Performance measurement, Organization design and structure for effective supply chain.	22

Text Books:

- Sunil Chopra, Peter Meindl and D.V. Kalara, Supply Chain Management, Strategy, Planning and Operation, Pearson Education Inc, 2007.
- Ronald H. Ballou, Business Logistics Management, Prentice Hall,1984
- R. P. Mohanty, S.G. Deshmukh, Supply chain Management(Theories & Practices), 2005

Reference Books:

- B. S. Sahay, Emerging issues in supply chain management, Macmillan, India. 2004

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: After completion of course, the student will be able to:

- CO1: Develop a sound understanding of the important role of supply chain management in today's business environment
- CO2:Become familiar with current supply chain management trends Understand and apply the current supply chain theories, practices and concepts utilizing case problems and problem-based learning situations
- CO3:Learn to use and apply computer-based supply chain optimization tools including the use of selected state of the art supply chain software suites currently used in business
- CO4:Develop and utilize critical management skills such as negotiating, working effectively within a diverse business environment, ethical decision making and use of information technology
- CO5:Demonstrate the use of effective written and oral communications, critical thinking, team building and presentation skills as applied to business problems
- CO6:Successfully complete a case project concluding with a written and oral presentation of the

findings

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1/PSO3
CO2	PO2/PSO2, PSO3
CO3	PO5/PSO3
CO4	PO8/PSO3
CO5	PO4/PSO3
CO6	PO3, PO4/PSO3

MME E0009 DESIGN OF PRODUCTION TOOLINGS

Objective: *Introduction to the concept of Jig and Fixtures, Types and applications, principle of design and constructions, Location and Clamping, Design of turning, milling, drilling & indexing, Hydraulic, Pneumatic and Pneumo-hydraulic devices for Jigs and Fixtures. Concept of press work, Punch and die clearance, Centre of pressure with calculation of blank diameter. Introduction of Dies for metal powder performs, design considerations, Basic models of flow & perform design. Concept of design of various types of tools for production of holes, surface of revolution and flat surface. Materials for cutting tools, cutting dies and forming dies. Introduction of Economics of Tooling and special features of Plastic as a tooling material.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit I** **Jigs & Fixtures:** Types and applications. Principle of design and constructions, Location and clamping. Design of turning, Milling, Drilling & Indexing Jigs and fixtures. Hydraulic, Pneumatic and pneumo-hydraulic devices for jigs and fixtures. **Cutting Tools:** Design of tools for the production of holes, surfaces of revolution, and flat surfaces like single point tools, form tools, drills, milling cutters. Materials for cutting tools, cutting dies and forming dies, Economics of Tooling. Plastics as a tooling material.	23
II	**Unit II** **Press Dies:** Classification of dies, components of dies assembly, Simple dies, compound dies, combination dies and progressive dies. Punch and die clearance, centre of pressure, and calculation of blank diameter. Design of cutting dies, forming dies and progressive dies. Dies for metal powder performs, design considerations, Basic models of flow & preform design.	22

Text Books:

6. Umesh Chandra & Surender Kumar, Production Engineering Design (Tool Design), Satya Prakashan, New Delhi
7. C. Donaldson G.H.Lecain and V.C.Goold, Tool Design, Tata McGraw Hill

Reference Books:

8. Osterguard E, Basic Die Making, Mc-Graw Hill Book Co
9. V.Arshinov, Metal Cutting & Tool Design, Mir Publication
10. Kortesoja, Victor A., Properties and Selection of Tool Material, ASM

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: *Upon* successful completion of this course, students would be able to:

CO1: The course intends to expose the students to the concept of Jig and Fixtures their principle of design and constructions with Locating and clamping.
CO2: Awareness of Hydraulic, Pneumatic and Pneumo-hydraulic devices used for Jig and Fixtures
CO3: Knowledge of Press Dies, classification, components of die assembly,
CO4: Dies for metal powder performs, design consideration.
CO5: Awareness the knowledge of cutting Tools, Design of tools for the production of holes, surface of Revaluation.
CO6: Able to know the materials for cutting tools, cutting dies and forming dies and plastic as a tooling material.

	POs	PSOs
CO1	PO1, PO3	
CO2	PO1	
CO3	PO1	
CO4	PO1, PO3	
CO5	PO1	
CO6	PO1, PO3	

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MME E0011 RAPID PROTOTYPING AND TOOLING

Objective: *The prime objective of this subject is to explore the automatic fabrication of 3D physical parts using additive manufacturing technology. To use of additive manufacturing for rapid prototyping takes designs from computer aided design (CAD), tessellates them in RP software and then build the actual physical 3D models in an additive manner layer-by-layer. Students are also able to explore various design aspects of machine tools elements like transmissions, structures, materials, kinematics, dynamics and construction of machine tools, etc. to understand concepts related to design of Die and Punch.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit I** Definition & Concept of Rapid Prototyping processes, Need of RP in context of batch production, Basic Principles of RP, Steps in RP, Process chain in RP in integrated CAD-CAM environment, Advantages of RP; Classifications of different RP techniques based on raw material, layering technique (2D or 3D) and energy sources; Process Technology, Basic concept & process detail of RP process like Stereo-lithography (SL), Solid foil polymerization, Selective laser sintering, Selective powder binding, Ballastic particle manufacturing both 2D and 3D, Fused Deposition Modelling, Shape Melting,	22
II	**Unit II** Laminated Object Manufacturing, Solid Ground Curing, Repetitive Masking and deposition, Beam Inference Solidification, Holographic Interference Solidification, Special Topic on RP using metallic alloys Solid ground curing laminated object manufacturing, fused deposition modeling, three dimensional printing, ballistic particle manufacturing & vacuum casting. Their advantages applications & limitation. Programming in RP, Modelling, Slicing, Internal Hatching, Surface Skin Fills, Support Structure Technology for Rapid Prototyping: a. Selection materials b. Development of 3D model & transforming it to the RP machine. c. Supporting techniques & development of the workpiece d. Post processing part removal, part cleaning, post curing, part finishing, machine accuracy & part accuracy. Some case studies & application of Auto industries, die industries, medical appliances, etc.	23

Text Books:

1. Paul F. Jacobs, Rapid prototyping & Manufacturing Fundamental of sterolithiography, SME Publications
2. Amitabh Ghosh, Rapid Prototyping, East West Press Pvt. Ltd
3. Chua C. K., Leong K. F. and Lim C. S., Rapid Prototyping, Principles and Application, World scientific publishing Co. Pvt. Ltd., Singapore

Reference Books:

1. Andreas gebhardt, Rapid prototyping, Hanser gardner publications, USA
2. Kenneth g. cooper, Rapid prototyping technology

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *After successful completion of this course the students are expected to be able to:*

CO1: Understand the importance of Rapid Prototyping Technology over the existing traditional methods in present competitive scenario in terms of product development cycle and cost.

CO2: Understand the insight into various modern rapid prototyping techniques,

CO3: Understand how the different processes work, how they have developed, applications, material used and strengths as well as weaknesses of each technology.

CO4: Develop the conceptual design, manufacturing framework and systematic analysis of design problems on the machine tools.

CO5: Understand the Technology for Rapid Prototyping;

CO6: Case studies and Applications of Auto Industries, die industries and medical appliances.

	POs	**PSOs**
CO1	PO1, PO2	PSO2
CO2	PO3	PSO2
CO3	PO1, PO3	PSO3
CO4	PO3	PSO2
CO5	PO1	PSO2
CO6	PO2	PSO3

MME E0012 NANOTECHNOLOGY AND ITS APPLICATION

Objective: *Subject structure mainly concerned with detailed introduction of nanomaterials. Why nanomaterials different with macro scale and microscale materials adequately discussed in this subject. Different manufacturing and synthesis techniques for nanoscale material and devices are major focus of the subject structure design. Various characterization techniques along with application in nano-micro equipment design is aim of this subject.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** The nanoscale dimension and paradigm, Definitions, history and current practice, structure, size dependence of properties, crystal structures, face centered cubic Nano particles, Lattice vibrations, methods of measuring properties atomic structures, crystallography, particle size, determination, surface structures. Transmission electron microscopy, field ion microscopy, scanning microscopy, infrared and Raman spectroscopy, photoemission and x-ray spectroscopy, magnetic resonance. Overview of current industry applications, Nanoscale science and engineering principles, Engineering principles for nanotechnology materials and applications.	22
II	**Unit-II** Carbon Nanotube Technologies (CNT), From graphite to buckyballs to CNT, Carbon nanotube applications and multi-walled carbon nano-tubes (MWCNT), Fabricating carbon nanotubes and nano-wall structures, Key applications of CNT and MWCNT, Nanolithography, Thin film processes, Imaging using scanning electron micro-scope (SEM), SPM-AFM, Traditional surface and materials analysis techniques, Molecular manufacturing, Self-assembly and 'bottom-up' manufacturing, Thin film applications, Thin film deposition processes, Applications in thin film deposition.	23
	Unit-III Quantum well, wires and dots- Introduction, preparation of quantum nanostructures, size and dimensionality effects, potential wells, nano machines and nano devices, microelectromechanical systems(MEMS), Nanoelectromechanical systems (NEMS).	

Text Books:

- P. Charles, Poole Jr. and Owens "Introduction to Nano technology" Wiley Inter science.
- Bharat Bhushan, "Springer Handbook of Nanotechnology" Springer.

Reference Books:

- Mark A Ratner "Nanotechnology a gentle introduction to the next big idea" Pearson Education and Company.
- H.F. Tibbalas "Introduction to nano science and nanotechnology" CRC Press.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

- CO1: Understand about types of nanomaterials
- CO2: Determine aspects ratio of nanomaterials
- **CO3: Understand characterization techniques required for various types of nanomaterials.**
- CO4: Perform physical and chemical analysis of nanomaterials
- **CO5: Understand various techniques of nano-material formation.**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs):

COs	**POs/PSOs**
CO1	PO1/PSO1
CO2	PO2/PSO3
CO3	PO1/PSO3
CO4	PO2/PSO3
CO5	PO1/PSO3

MME E0015 RELIABILITY & MAINTENANCE

Objective: *The aim of this course is to provide fundamental concepts of reliability and maintenance in engineering discipline. It describes scientific know-how to a component, assembly, plant, or process work so it will perform its intended function, without failure, for the required time duration when installed and operated correctly in a specified environment and referred maintenance planning to prevent the failure.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **Reliability Engineering:** System reliability - series, parallel and mixed configurations, block diagram, r-out-of-n structure. Reliability improvement and allocation-Difficulty in achieving reliability, method of improving reliability during design, different techniques available to improve reliability, Reliability – Cost trade off, Prediction and analysis. Maintainability & Availability: Maintainability & Availability –Techniques available to improve maintainability & availability, trade off among reliability, maintainability & availability, simple problems. **Maintenance Planning and Replacement:** Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Replacement decisions, – group replacement.	22
II	**Unit-II** **Failure Analysis**: Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis. **Maintenance Systems:** Fixed time maintenance, Condition based maintenance, Operate to failure, Opportunity maintenance, design out maintenance, Total productive maintenance, Concept of terrotechnology. Condition Monitoring and Diagnostics: Levels of condition monitoring, Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, noise and sound monitoring, Frequency of condition monitoring.	23

Text Books:

1. L.S. Srinath, "Concepts in Reliability Engineering": Affiliated East West Press (P) Ltd., 1985.
2. R.C. Mishra and K. Pathak, "Maintenance Engineering & Management": Prentice Hall of India, New Delhi, 2015.
3. S.K. Srivastava, "Industrial Maintenance Management": S. Chand & Co Ltd, 1981.

Reference Books:

1. Dr. A.K. Gupta, "Reliability Maintenance & Safety Engineering": University Science Press New Delhi, 2009.
2. Kelly and M.J. Harris, "Management of Industrial Maintenance": Boston : Newnes-Butterworths, 1979.
3. B.S. Dhillon, "Engineering Maintainability: How to Design for Reliability and Easy Maintenance": Prentice Hall of India, New Delhi, 1999.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

After completion of course, the student will be able to:

- CO1: Understand maintenance objectives and evaluate maintenance strategies for process plant applications.
- CO2: Evaluate maintenance schedules and assess the corresponding risks with appropriate tools & techniques.
- CO3: Understand the concept of maintainability & availability and different techniques available to improve maintainability & availability.
- CO4: To develop the total optimum cost model for a maintenance problem.
- CO5: Understand the concept of reliability & its techniques for estimating reliability and characteristics of components/systems.
- CO6: Understand and apply the concept of reliability centered maintenance (RCM) and advantages for a company employing them.
- CO7: Understand and apply the concept of condition monitoring techniques & its data for predictive maintenance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO1/PO5/PSO2
CO3	PO1/PSO2
CO4	PO3/PSO1
CO5	PO4/PSO2
CO6	PO6/PSO2/ PSO3
CO7	PO4/PSO2

MME E0016 COMPUTER-BASED NUMERICAL-TECHNIQUES AND SOFT-COMPUTING

Objective: *Conceptual understanding of mathematics, numerical analysis, statistics, computer and information sciences which underpin the engineering discipline. Introduce students to soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world and engineering problems. Introduce students to genetic algorithm fundamentals and its operators and procedure. Explain the students about fuzzy sets and its operations, Introduce students to fuzzy systems, fuzzy logic and its applications. Explain the students about Artificial Neural Networks and various categories of ANN. Explain the students about different types hybrid systems.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Review & updates of computer, applications & programming: Brief review & updates of concepts & applications of computer and computer-programming. Modern trends. Numerical Techniques: Interpolation & extrapolation, Finding roots of equation & optimization. Least-square-fitting. Laplace-Transform as (non-numerical) solution of differential equations. Numerical Differentiation and Integration, Solving Differential Equations numerically. FEM introduction & applications. Artificial Neural Network: Concept of Artificial-Neural-Network (ANN),	23
II	**Unit-II** Supervised & unsupervised learning. Back-propagation algorithm for ANN and possible applications. Fuzzy Logic & Controller: Concept of Fuzzy-Logic, Fuzzy-logic Controller with an example of, say, water-heater (geyser). Genetic-Algorithm and Simulated-Annealing: Introduction to global optimization techniques such as Genetic-Algorithm (GA) and Simulated-Annealing etc .	22

Text Books:

1. Rajesh Kumar Gupta, Numerical Methods: Fundamentals and Applications, CAMBRIDGE University press, 2019
2. Saroj kaushik and Sunita tiwari, Soft computing, MC Graw Hill India Pvt Ltd,2018
3. SN Sivanandan, S Sumathi, S N Deepa, Introduction of neural network using MATLAB 6.0, MC Graw Hill India Pvt Ltd, 2015.

Reference Books:

1. Kalyanmoy Deb, Optimization Methods, Prentice Hall of India, 1995
2. Rao & Rao, C++ Neural Network and Fuzzy Logic, BPB Publications, 2003
3. Rajasekaran and Vijayalakshmi Pai, Neural Network, Fuzzy Logic and Genetic Algorithm, PHI Learning, 2003

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the students will be able to:*

CO1: Solve large systems of simultaneous linear equations. Find eigen values and eigenvectors of a matrix.

CO2: Use the least-squares method to obtain a function for data analysis.

CO3: Find solutions of non-linear equations using bisection method, Newton's methods and secant method and implement using a computer.

CO4: *Estimate the solutions of systems of first order ordinary differential equations or higher order ordinary differential equations using various numerical methods and implement using a computer.*

CO5: *Learn about soft computing techniques and their applications. Analyze various neural network architectures. Understand perceptions and counter propagation networks. Define the fuzzy systems. Analyze the genetic algorithms and their applications.*

Mapping of Course Outcome (COs) with program outcome and program specific outcomes

COs	**POs/PSOs**
CO1	PO1/PSO1
CO2	PO2/PSO3
CO3	PO2/PSO1
CO4	PO3/PSO3
CO5	PO2/PSO3

MME E0017 MICRO MANUFACTURING

Objective: *Meso and micro manufacturing are emerging as an important technology especially in the areas where miniaturization yields economic and technical benefits, namely, aerospace, automotive, optical, biomedical and similar other areas. The basic objective of the present course is to acquaint the participants with the principles, basic machine tools, developments in the micro-manufacturing processes, micro and nano metrology and research trends in the area of micro-manufacturing processes. Thus, this course will deal with various areas of micro manufacturing including.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	Micro Manufacturing : An Introduction Challenges in Meso, Micro and Nano Manufacturing Micro Turning, Micromilling and Microdrilling Micro Grinding Abrasive Jet Micromachining, Ultrasonic Micromachining, Abrasive Water Jet Micromachining Electric Discharge Micromachining, Laser Beam Micromachining, Electron Beam Micromachining Electrochemical Micromachining Micro and Nano Manufacturing by Focused Ion Beam	20
II	Magnetorheological and Allied Finishing Processes Magnetic Abrasive Finishing (MAF) Abrasive Flow Finishing (AFF) Introduction to Micro joining Laser Micro Welding Electron Beams Micro Welding Introduction to Micro forming Micro Extrusion Micro Bending with Laser Dimension Metrology for Micro/Meso-Scale Manufacturing Introduction to Micro molding - A Soft Lithography Technique Introduction to Fabrication of Microelectronic Devices	20

Text Books:

1. V.K. Jain, Editor, "Introduction to Micro Machining":Narosa Publication House, 2010.
2. M.k. singh, "Unconventional manufacturing process": New age international publisher, 2008.

Reference Books:

1. Muammerkoc, tugrulozel, "Micro-Manufacturing: Design and Manufacturing of Micro-Products": Wiley, 2011.
2. Yi qin, "Micro-manufacturing engineering and technology": Elsevier, 2010.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: **After completion of the course, student will be able to:**

CO1: Recognize different Micro Manufacturing systems & their applications in different types of production, automation, FMS.

CO2: Model the material removal and tool wear rate in various micro machining processes.

CO3: Analyze the processes, detail of types of micro machining processes and evaluate the need of micro machining processes.

CO4: Evaluate the role of each process parameter during micro machining of various advanced materials.

CO5. Design the requirements to achieve best quality of machined surface while micro machining of various industrial engineering materials.

CO6: Understand and select various measurement techniques in micro machining processes.

CO7: Understand of mechanics at micro level machining and capabilities of different micro-manufacturing processes.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

COs	POs/PSOs
CO1	**PO1,PO12 / PSO2**
CO2	**PO1,PO3,PO5 / PSO2**
CO3	**PO2, PO3 / PSO2**
CO4	**PO2, PO3,PO4 / PSO2**
CO5	**PO3,PO7 / PSO**
CO6	**PO2,PO3,PO5 / PSO2**
CO7	**PO4,PO12/PSO2**

MME E0018 CONCURRENT ENGINEERING

Objective: *It refers to an approach used in product development in which functions of design engineering, manufacturing engineering and other functions are integrated to reduce the elapsed time required to bring a new product to the market. Concurrent Engineering is a systematic approach to the integrated, concurrent design of products and their related processes, including, manufacturing and support. This approach is intended to cause the developers from the very outset to consider all elements of the product life cycle, from conception to disposal, including quality, cost, schedule, and user requirements.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Introduction: Product development objectives and product development cycle. Background and challenges faced by modern production environment, Sequential engineering process. Concurrent engineering: Definition need and utility, Objectives of CE, Benefits of CE, Life cycle design of products, Life cycle costs. Support for CE: Classes of support for CE activity, CE organizational, Structure CE, Team composition and duties, Computer based Support, CE Implementation Process. Design Product for Customer: Industrial Design, Quality Function Deployment, Translation process of quality function deployment (QFD).	22
II	**Unit-II** Modeling of Concurrent Engineering Design: Compatibility approach, Compatibility index, Implementation of the Compatibility model, Integrating the compatibility concerns. Design for Manufacture (DFM): Introduction, Role of DFM is CE, DFM methods, e.g. value engineering, DFM guidelines, Design for assembly, Creative design methods, Product family themes, Design axioms, Robust design: Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability. Quality by Design: Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach. Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.	23

Text Books:

1. Kusiak John, Concurrent Engineering, Wiley
2. Concurrent Engineering Menon Chapman & hall
3. M.M. Anderson and L Hein, integrated Product Development, IFS Publications

Reference Books:

1. J. Cleetus, Design for Concurrent Engineering, CE Research Centre, Morgantown
2. Prasad, Concurrent Engineering Fundamentals: Integrated Product Development, Prentice hall India
3. I. Moustapha , Concurrent Engineering in Product Design and Development , New Age International
4. John Stark, Product Lifecycle Management, Springer-Verlag, UK
5. Michael Grieves, Product Lifecycle Management, McGraw Hill

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: *Upon* successful completion of this course, students would be able to:

CO1: An expression for the ambition to increase the competitiveness by decreasing the lead-time and still improving quality and cost;
CO2: Design modern way to develop new products.
CO3: Handle issues of high costs, product robustness and long lead times associated with product development;
CO4: Basic knowledge of design of manufacture methods and value engineering.
CO5: Able to gain the knowledge of design for reliability,
CO6: Able to design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

	POs	PSOs
CO1	PO1, PO2, PO3	PS01
CO2	PO2,PO3	PSO1
CO3	PO2,PO3	PSO1
CO4	PO1,PO2	PSO1
CO5	PO1	PSO1
CO6	PO1,PO3	PSO1, PSO3

MME E0019 TECHNOLOGY OF COMPETITIVE MANUFACTURING

Objective: *The basic objective of the present course is to acquaint the participants with the conceptual framework and formulation different manufacturing strategies for competitive environment. and to understand the concept of value engineering, lean manufacturing, six sigma to improve effectiveness of the product and processes. Participants are able to identify and asses new technologies to design and planning of futuristic factories.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Manufacturing Strategy: Conceptual framework and competitive environment, manufacturing problems, Manufacturing Audit and strategy formulation, Diagnostic review and opportunity assessment. Technological strategy: Strategic planning, product and process design for improved Manufacturability and producibility, identification and assessment of new technologies. Value Engineering: Concept of Value & function, reasons for unnecessary cost, methodology & techniques, acceptance problems, value engineering effectiveness, profit impact of value engineering, industrial and business applications.	22
II	**Unit-II** Lean Manufacturing: concept, goals, components, tools and techniques, JIT, KANBAN system, waste reduction. Six sigma as manufacturing strategy: Concept, methodology and applications Building Manufacturing Competitiveness: SIPOC analysis, focused manufacturing, agile manufacturing, intelligent manufacturing, digital manufacturing, rapid response manufacturing and customer satisfaction. Concept of flexibility and flexible manufacturing systems, Decision and choice regarding FMS configuration. Factories of future: Nature and categories of FOF, Zero bases FOF, Design and planning for futuristic factories.	23

Text Books:

1. Skimmar,Wickham, Manufacturing in the corporate Strategy, John Wiley and sons, NewYork
2. Hearm Buck and Butler, D.M., Economic product Design, Colhins, London

Reference Books:

1. Cluttarbuck, JIT – A Global Status Report, IFS publications
2. Michael J. Termini, The new manufacturing engineer, Society of manufacture engineer Michigan, USA

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, Students will be able to:*

CO1: Formulate and review the manufacturing strategies for competitive environment;

CO2: Knowledge about Strategic planning, product and process design for improved Manufacturability and Producibility;

CO3: Knowledge about Value Engineering, methodology & techniques, acceptance problems, value engineering effectiveness, profit impact of value engineering, industrial and business applications;

CO4: Knowledge about the Lean Manufacturing, tools and techniques, JIT, KANBAN system, waste reduction;

CO5: Knowledge about the Six sigma, SIPOC analysis, focused manufacturing, agile manufacturing, intelligent manufacturing, digital manufacturing, rapid response manufacturing and customer satisfaction;

CO6: Factories of future: Nature and categories of FOF, Zero Bases FOF, Design and planning for futuristic factories.

	POs	*PSOs*
CO1	*PO1,PO2*	*PSO2*
CO2	*PO1, PO3*	*PSO3*
CO3	*PO1,PO2*	*PSO2*
CO4	*PO1*	*PSO2*
CO5	*PO1*	*PSO2, PSO3*
CO6	*PO1,PO3*	*PSO2*

MME E0011 RAPID PROTOTYPING AND TOOLING

Objective: *The prime objective of this subject is to explore the automatic fabrication of 3D physical parts using additive manufacturing technology. To use of additive manufacturing for rapid prototyping takes designs from computer aided design (CAD), tessellates them in RP software and then build the actual physical 3D models in an additive manner layer-by-layer. Students are also able to explore various design aspects of machine tools elements like transmissions, structures, materials, kinematics, dynamics and construction of machine tools, etc. to understand concepts related to design of Die and Punch.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit I** Definition & Concept of Rapid Prototyping processes, Need of RP in context of batch production, Basic Principles of RP, Steps in RP, Process chain in RP in integrated CAD-CAM environment, Advantages of RP; Classifications of different RP techniques based on raw material, layering technique (2D or 3D) and energy sources; Process Technology, Basic concept & process detail of RP process like Stereo-lithography (SL), Solid foil polymerization, Selective laser sintering, Selective powder binding, Ballastic particle manufacturing both 2D and 3D, Fused Deposition Modelling, Shape Melting,	22
II	**Unit II** Laminated Object Manufacturing, Solid Ground Curing, Repetitive Masking and deposition, Beam Inference Solidification, Holographic Interference Solidification, Special Topic on RP using metallic alloys Solid ground curing laminated object manufacturing, fused deposition modeling, three dimensional printing, ballistic particle manufacturing & vacuum casting. Their advantages applications & limitation. Programming in RP, Modelling, Slicing, Internal Hatching, Surface Skin Fills, Support Structure Technology for Rapid Prototyping: e. Selection materials f. Development of 3D model & transforming it to the RP machine. g. Supporting techniques & development of the workpiece h. Post processing part removal, part cleaning, post curing, part finishing, machine accuracy & part accuracy. Some case studies & application of Auto industries, die industries, medical appliances, etc.	23

Text Books:

4. Paul F. Jacobs, Rapid prototyping & Manufacturing Fundamental of sterolithiography, SME Publications
5. Amitabh Ghosh, Rapid Prototyping, East West Press Pvt. Ltd
6. Chua C. K., Leong K. F. and Lim C. S., Rapid Prototyping, Principles and Application, World scientific publishing Co. Pvt. Ltd., Singapore

Reference Books:

3. Andreas gebhardt, Rapid prototyping, Hanser gardner publications, USA
4. Kenneth g. cooper, Rapid prototyping technology

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *After successful completion of this course the students are expected to be able to:*

CO1: Understand the importance of Rapid Prototyping Technology over the existing traditional methods in present competitive scenario in terms of product development cycle and cost.

CO2: Understand the insight into various modern rapid prototyping techniques,

CO3: Understand how the different processes work, how they have developed, applications, material used and strengths as well as weaknesses of each technology.

CO4: Develop the conceptual design, manufacturing framework and systematic analysis of design problems on the machine tools.

CO5: Understand the Technology for Rapid Prototyping;

CO6: Case studies and Applications of Auto Industries, die industries and medical appliances.

	POs	**PSOs**
CO1	PO1, PO2	PSO2
CO2	PO3	PSO2
CO3	PO1, PO3	PSO3
CO4	PO3	PSO2
CO5	PO1	PSO2
CO6	PO2	PSO3

MME E0012 NANOTECHNOLOGY AND ITS APPLICATION

Objective: *Subject structure mainly concerned with detailed introduction of nanomaterials. Why nanomaterials different with macro scale and microscale materials adequately discussed in this subject. Different manufacturing and synthesis techniques for nanoscale material and devices are major focus of the subject structure design. Various characterization techniques along with application in nano-micro equipment design is aim of this subject.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** The nanoscale dimension and paradigm, Definitions, history and current practice, structure, size dependence of properties, crystal structures, face centered cubic Nano particles, Lattice vibrations, methods of measuring properties atomic structures, crystallography, particle size, determination, surface structures. Transmission electron microscopy, field ion microscopy, scanning microscopy, infrared and Raman spectroscopy, photoemission and x-ray spectroscopy, magnetic resonance. Overview of current industry applications, Nanoscale science and engineering principles, Engineering principles for nanotechnology materials and applications.	22
II	**Unit-II** Carbon Nanotube Technologies (CNT), From graphite to buckyballs to CNT, Carbon nanotube applications and multi-walled carbon nano-tubes (MWCNT), Fabricating carbon nanotubes and nano-wall structures, Key applications of CNT and MWCNT, Nanolithography, Thin film processes, Imaging using scanning electron micro-scope (SEM), SPM-AFM, Traditional surface and materials analysis techniques, Molecular manufacturing, Self-assembly and 'bottom-up' manufacturing, Thin film applications, Thin film deposition processes, Applications in thin film deposition. **Unit-III** Quantum well, wires and dots- Introduction, preparation of quantum nanostructures, size and dimensionality effects, potential wells, nano machines and nano devices, microelectromechanical systems(MEMS), Nanoelectromechanical systems (NEMS).	23

Text Books:

- P. Charles, Poole Jr. and Owens "Introduction to Nano technology" Wiley Inter science.
- Bharat Bhushan, "Springer Handbook of Nanotechnology" Springer.

Reference Books:

- Mark A Ratner "Nanotechnology a gentle introduction to the next big idea" Pearson Education and Company.
- H.F. Tibbalas "Introduction to nano science and nanotechnology" CRC Press.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

- CO1: Understand about types of nanomaterials
- CO2: Determine aspects ratio of nanomaterials
- **CO3: Understand characterization techniques required for various types of nanomaterials.**
- CO4: Perform physical and chemical analysis of nanomaterials
- **CO5: Understand various techniques of nano-material formation.**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs):

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2/PSO3
CO3	PO1/PSO3
CO4	PO2/PSO3
CO5	PO1/PSO3

MME E0015 RELIABILITY & MAINTENANCE

Objective: *The aim of this course is to provide fundamental concepts of reliability and maintenance in engineering discipline. It describes scientific know-how to a component, assembly, plant, or process work so it will perform its intended function, without failure, for the required time duration when installed and operated correctly in a specified environment and referred maintenance planning to prevent the failure.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **Reliability Engineering:** System reliability - series, parallel and mixed configurations, block diagram, r-out-of-n structure. Reliability improvement and allocation-Difficulty in achieving reliability, method of improving reliability during design, different techniques available to improve reliability, Reliability – Cost trade off, Prediction and analysis. Maintainability & Availability: Maintainability & Availability –Techniques available to improve maintainability & availability, trade off among reliability, maintainability & availability, simple problems. **Maintenance Planning and Replacement:** Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Replacement decisions, – group replacement.	22
II	**Unit-II** **Failure Analysis**: Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis. **Maintenance Systems:** Fixed time maintenance, Condition based maintenance, Operate to failure, Opportunity maintenance, design out maintenance, Total productive maintenance, Concept of terrotechnology. Condition Monitoring and Diagnostics: Levels of condition monitoring, Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, noise and sound monitoring, Frequency of condition monitoring.	23

Text Books:

4. L.S. Srinath, "Concepts in Reliability Engineering": Affiliated East West Press (P) Ltd., 1985.
5. R.C. Mishra and K. Pathak, "Maintenance Engineering & Management": Prentice Hall of India, New Delhi, 2015.
6. S.K. Srivastava, "Industrial Maintenance Management": S. Chand & Co Ltd, 1981.

Reference Books:

4. Dr. A.K. Gupta, "Reliability Maintenance & Safety Engineering": University Science Press New Delhi, 2009.
5. Kelly and M.J. Harris, "Management of Industrial Maintenance": Boston : Newnes-Butterworths, 1979.
6. B.S. Dhillon, "Engineering Maintainability: How to Design for Reliability and Easy Maintenance": Prentice Hall of India, New Delhi, 1999.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

After completion of course, the student will be able to:

- CO1: Understand maintenance objectives and evaluate maintenance strategies for process plant applications.
- CO2: Evaluate maintenance schedules and assess the corresponding risks with appropriate tools & techniques.
- CO3: Understand the concept of maintainability & availability and different techniques available to improve maintainability & availability.
- CO4: To develop the total optimum cost model for a maintenance problem.
- CO5: Understand the concept of reliability & its techniques for estimating reliability and characteristics of components/systems.
- CO6: Understand and apply the concept of reliability centered maintenance (RCM) and advantages for a company employing them.
- CO7: Understand and apply the concept of condition monitoring techniques & its data for predictive maintenance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO1/PO5/PSO2
CO3	PO1/PSO2
CO4	PO3/PSO1
CO5	PO4/PSO2
CO6	PO6/PSO2/ PSO3
CO7	PO4/PSO2

MME E0016 COMPUTER-BASED NUMERICAL-TECHNIQUES AND SOFT-COMPUTING

Objective: *Conceptual understanding of mathematics, numerical analysis, statistics, computer and information sciences which underpin the engineering discipline. Introduce students to soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world and engineering problems. Introduce students to genetic algorithm fundamentals and its operators and procedure. Explain the students about fuzzy sets and its operations, Introduce students to fuzzy systems, fuzzy logic and its applications. Explain the students about Artificial Neural Networks and various categories of ANN. Explain the students about different types hybrid systems.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Review & updates of computer, applications & programming: Brief review & updates of concepts & applications of computer and computer-programming. Modern trends. Numerical Techniques: Interpolation & extrapolation, Finding roots of equation & optimization. Least-square-fitting. Laplace-Transform as (non-numerical) solution of differential equations. Numerical Differentiation and Integration, Solving Differential Equations numerically. FEM introduction & applications. Artificial Neural Network: Concept of Artificial-Neural-Network (ANN),	23
II	**Unit-II** Supervised & unsupervised learning. Back-propagation algorithm for ANN and possible applications. Fuzzy Logic & Controller: Concept of Fuzzy-Logic, Fuzzy-logic Controller with an example of, say, water-heater (geyser). Genetic-Algorithm and Simulated-Annealing: Introduction to global optimization techniques such as Genetic-Algorithm (GA) and Simulated-Annealing etc .	22

Text Books:

4. Rajesh Kumar Gupta, Numerical Methods: Fundamentals and Applications, CAMBRIDGE University press, 2019
5. Saroj kaushik and Sunita tiwari, Soft computing, MC Graw Hill India Pvt Ltd,2018
6. SN Sivanandan, S Sumathi, S N Deepa, Introduction of neural network using MATLAB 6.0, MC Graw Hill India Pvt Ltd, 2015.

Reference Books:

4. Kalyanmoy Deb, Optimization Methods, Prentice Hall of India, 1995
5. Rao & Rao, C++ Neural Network and Fuzzy Logic, BPB Publications, 2003
6. Rajasekaran and Vijayalakshmi Pai, Neural Network, Fuzzy Logic and Genetic Algorithm, PHI Learning, 2003

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the students will be able to:*

CO1: Solve large systems of simultaneous linear equations. Find eigen values and eigenvectors of a matrix.
CO2: Use the least-squares method to obtain a function for data analysis.
CO3: Find solutions of non-linear equations using bisection method, Newton's methods and secant method and implement using a computer.
CO4: *Estimate the solutions of systems of first order ordinary differential equations or higher order ordinary differential equations using various numerical methods and implement using a computer.*

CO5: *Learn about soft computing techniques and their applications. Analyze various neural network architectures. Understand perceptions and counter propagation networks. Define the fuzzy systems. Analyze the genetic algorithms and their applications.*

Mapping of Course Outcome (COs) with program outcome and program specific outcomes

COs	**POs/PSOs**
CO1	PO1/PSO1
CO2	PO2/PSO3
CO3	PO2/PSO1
CO4	PO3/PSO3
CO5	PO2/PSO3

MME E0017 MICRO MANUFACTURING

Objective: *Meso and micro manufacturing are emerging as an important technology especially in the areas where miniaturization yields economic and technical benefits, namely, aerospace, automotive, optical, biomedical and similar other areas. The basic objective of the present course is to acquaint the participants with the principles, basic machine tools, developments in the micro-manufacturing processes, micro and nano metrology and research trends in the area of micro-manufacturing processes. Thus, this course will deal with various areas of micro manufacturing including.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	Micro Manufacturing : An Introduction Challenges in Meso, Micro and Nano Manufacturing Micro Turning, Micromilling and Microdrilling Micro Grinding Abrasive Jet Micromachining, Ultrasonic Micromachining, Abrasive Water Jet Micromachining Electric Discharge Micromachining, Laser Beam Micromachining, Electron Beam Micromachining Electrochemical Micromachining Micro and Nano Manufacturing by Focused Ion Beam	20
II	Magnetorheological and Allied Finishing Processes Magnetic Abrasive Finishing (MAF) Abrasive Flow Finishing (AFF) Introduction to Micro joining Laser Micro Welding Electron Beams Micro Welding Introduction to Micro forming Micro Extrusion Micro Bending with Laser Dimension Metrology for Micro/Meso-Scale Manufacturing Introduction to Micro molding - A Soft Lithography Technique Introduction to Fabrication of Microelectronic Devices	20

Text Books:

3. V.K. Jain, Editor, “Introduction to Micro Machining”:Narosa Publication House, 2010.
4. M.k. singh, “Unconventional manufacturing process”: New age international publisher, 2008.

Reference Books:

3. Muammerkoc, tugrulozel, “Micro-Manufacturing: Design and Manufacturing of Micro-Products”: Wiley, 2011.
4. Yi qin, “Micro-manufacturing engineering and technology”: Elsevier, 2010.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:**After completion of the course, student will be able to:**

CO1: Recognize different Micro Manufacturing systems & their applications in different types of production, automation, FMS.

CO2: Model the material removal and tool wear rate in various micro machining processes.

CO3: Analyze the processes, detail of types of micro machining processes and evaluate the need of micro machining processes.

CO4: Evaluate the role of each process parameter during micro machining of various advanced materials.

CO5. Design the requirements to achieve best quality of machined surface while micro machining of various industrial engineering materials.

CO6: Understand and select various measurement techniques in micro machining processes.

CO7: Understand of mechanics at micro level machining and capabilities of different micro-manufacturing processes.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

COs	**POs/PSOs**
CO1	**PO1,PO12 / PSO2**
CO2	**PO1,PO3,PO5 / PSO2**
CO3	**PO2, PO3 / PSO2**
CO4	**PO2, PO3,PO4 / PSO2**
CO5	**PO3,PO7 / PSO**
CO6	**PO2,PO3,PO5 / PSO2**
CO7	**PO4,PO12/PSO2**

MME E0018 CONCURRENT ENGINEERING

Objective: *It refers to an approach used in* product development *in which functions of design engineering, manufacturing engineering and other functions are integrated to reduce the elapsed time required to bring a new product to the market. Concurrent Engineering is a systematic approach to the integrated, concurrent design of products and their related processes, including, manufacturing and support. This approach is intended to cause the developers from the very outset to consider all elements of the product life cycle, from conception to disposal, including quality, cost, schedule, and user requirements.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Introduction: Product development objectives and product development cycle. Background and challenges faced by modern production environment, Sequential engineering process. Concurrent engineering: Definition need and utility, Objectives of CE, Benefits of CE, Life cycle design of products, Life cycle costs. Support for CE: Classes of support for CE activity, CE organizational, Structure CE, Team composition and duties, Computer based Support, CE Implementation Process. Design Product for Customer: Industrial Design, Quality Function Deployment, Translation process of quality function deployment (QFD).	22
II	**Unit-II** Modeling of Concurrent Engineering Design: Compatibility approach, Compatibility index, Implementation of the Compatibility model, Integrating the compatibility concerns. Design for Manufacture (DFM): Introduction, Role of DFM is CE, DFM methods, e.g. value engineering, DFM guidelines, Design for assembly, Creative design methods, Product family themes, Design axioms, Robust design: Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability. Quality by Design: Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach. Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.	23

Text Books:

4. Kusiak John, Concurrent Engineering, Wiley
5. Concurrent Engineering Menon Chapman & hall
6. M.M. Anderson and L Hein, integrated Product Development, IFS Publications

Reference Books:

6. J. Cleetus, Design for Concurrent Engineering, CE Research Centre, Morgantown
7. Prasad, Concurrent Engineering Fundamentals: Integrated Product Development, Prentice hall India
8. I. Moustapha , Concurrent Engineering in Product Design and Development , New Age International
9. John Stark, Product Lifecycle Management, Springer-Verlag, UK
10. Michael Grieves, Product Lifecycle Management, McGraw Hill

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Course Outcome: *Upon* successful completion of this course, students would be able to:

CO1: An expression for the ambition to increase the competitiveness by decreasing the lead-time and still improving quality and cost;
CO2: Design modern way to develop new products.
CO3: Handle issues of high costs, product robustness and long lead times associated with product development;
CO4: Basic knowledge of design of manufacture methods and value engineering.
CO5: Able to gain the knowledge of design for reliability,
CO6: Able to design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

	POs	PSOs
CO1	PO1, PO2, PO3	PS01
CO2	PO2,PO3	PSO1
CO3	PO2,PO3	PSO1
CO4	PO1,PO2	PSO1
CO5	PO1	PSO1
CO6	PO1,PO3	PSO1, PSO3

MME E0019 TECHNOLOGY OF COMPETITIVE MANUFACTURING

Objective: *The basic objective of the present course is to acquaint the participants with the conceptual framework and formulation different manufacturing strategies for competitive environment. and to understand the concept of value engineering, lean manufacturing, six sigma to improve effectiveness of the product and processes. Participants are able to identify and asses new technologies to design and planning of futuristic factories.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Manufacturing Strategy: Conceptual framework and competitive environment, manufacturing problems, Manufacturing Audit and strategy formulation, Diagnostic review and opportunity assessment. Technological strategy: Strategic planning, product and process design for improved Manufacturability and producibility, identification and assessment of new technologies. Value Engineering: Concept of Value & function, reasons for unnecessary cost, methodology & techniques, acceptance problems, value engineering effectiveness, profit impact of value engineering, industrial and business applications.	22
II	**Unit-II** Lean Manufacturing: concept, goals, components, tools and techniques, JIT, KANBAN system, waste reduction. Six sigma as manufacturing strategy: Concept, methodology and applications Building Manufacturing Competitiveness: SIPOC analysis, focused manufacturing, agile manufacturing, intelligent manufacturing, digital manufacturing, rapid response manufacturing and customer satisfaction. Concept of flexibility and flexible manufacturing systems, Decision and choice regarding FMS configuration. Factories of future: Nature and categories of FOF, Zero bases FOF, Design and planning for futuristic factories.	23

Text Books:

3. Skimmar,Wickham, Manufacturing in the corporate Strategy, John Wiley and sons, NewYork
4. Hearm Buck and Butler, D.M., Economic product Design, Colhins, London

Reference Books:

3. Cluttarbuck, JIT – A Global Status Report, IFS publications
4. Michael J. Termini, The new manufacturing engineer, Society of manufacture engineer Michigan, USA

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, Students will be able to:*

CO1: Formulate and review the manufacturing strategies for competitive environment;

CO2: Knowledge about Strategic planning, product and process design for improved Manufacturability and Producibility;

CO3: Knowledge about Value Engineering, methodology & techniques, acceptance problems, value engineering effectiveness, profit impact of value engineering, industrial and business applications;

CO4: Knowledge about the Lean Manufacturing, tools and techniques, JIT, KANBAN system, waste reduction;

CO5: Knowledge about the Six sigma, SIPOC analysis, focused manufacturing, agile manufacturing, intelligent manufacturing, digital manufacturing, rapid response manufacturing and customer satisfaction;

CO6: Factories of future: Nature and categories of FOF, Zero Bases FOF, Design and planning for futuristicfactories.

	POs	PSOs
CO1	PO1,PO2	PSO2
CO2	PO1, PO3	PSO3
CO3	PO1,PO2	PSO2
CO4	PO1	PSO2
CO5	PO1	PSO2, PSO3
CO6	PO1,PO3	PSO2

Open Elective (Offer to other Departments)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BME 00002	Energy Conservation & Management	3	1	0	0	4	4	Non-Conventional Energy Recourses
2.	BME 00003	Smart Materials	3	1	0	0	4	4	Material Science
3.	BME 00004	Project Management	3	1	0	0	4	4	Industrial Engineering
4.	BME 00005	Reliability and Maintenance Engineering	3	1	0	0	4	4	Industrial Engineering
5.	BME 00006	Mechatronics	3	1	0	0	4	4	Sensors and actuators
6.	BME 00007	Six Sigma & Applications	3	1	0	0	4	4	Quality Control

BMEO0002ENERGYCONSERVATIONANDMANAGEMENT

Objective: *The main objective of this course is to understand the principles associated with effective energymanagement and to apply these principles in the day-to-day life. To gain exposure to energy auditing, to identifyenergy conservation opportunities in various industrial processes and to evaluate the performance of boilers,furnacesandotherenergyintensiveequipment/processes.*

Credits:04 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **INTRODUCTION:** Principles of energy management. Managerial organization,Functionalareasfori)manufacturingindustry,ii)Processindustry,iii)Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating,Organizingandmanaging energymanagementprograms **ENERGY AUDIT:** Definition and concepts. Types of energy audits, Basic energyconcepts,Resourcesforplantenergystudies.Datagathering,Analyticaltechniques.**EnergyConservation:**Technologiesforenergyconservation,Designforconservationofenergymaterials,Energyflownetworks.Criticalassessmentof energy usage. Formulation of objectives and constrains, Synthesis of alternativeoptionsandtechnicalanalysisof options.Processintegration.	23
II	**Unit-II** **ENERGYEFFICIENCY:**FuelsandCombustion-Boilers-SteamSystem-Furnaces -InsulationandRefractory-FBCBoilers-Cogeneration-Wasteheatrecovery,DieselGeneratingSystem. **ENERGYPERFORMANCEASSESSMENT:**EquipmentandUtilitysystems-Boilers-Furnaces-Cogeneration, Turbines (Gas, Steam)- Heat Exchangers-ElectricMotors and Variable Speed, Drives-Fans and Blowers-Water Pumps-Compressors.**ALTERNATIVE ENERGY SOURCES:** Solar energy: Types of devices for solarenergycollections,Thermalstoragesystem,Controlsystems.WindEnergy, Availability,WindDevices,WindCharacteristics,performanceofturbinesandsystems. WasteMinimizationandResourceConservation.	22

TextBooks:

- H.KoontzandCyrillDonnel"Management" McGrawHill
- S.C.Kuchhal"FinancialManagement"ChaitanyaPublishingHouse.

ReferenceBooks:

- W. C., Turner and S. Doty "Energy Management Hand Book" FairmontPress, 2009, 7thedition.
- C.BSmith"EnergyManagementPrinciples"PergamonPress,2007
- W.RMurphy"EnergyManagement"Elsevier,2007.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes:

CO1:Understandingofenergyconservationand identificationofenergyconservation,opportunitiesinvariousindustrialprocesses.

CO2:Knowledgeofvarioustoolsandcomponentsenergyauditing.

CO3:Abilitytoevaluate theperformanceofindustrialboilers,furnacesetc.bydirectandindirectmethods.

CO4:toinvestigatecogeneration inindustryandwasteheatrecoverytechniquesanddevices.

CO5:Toconductenergyauditsindomesticandsmallindustries.

CO6:Applyknowledgetodevelopmodelandprototypeswhichcanrecoverwasteheatforenergyefficiency.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)

+):

COs	POs
CO1	PO1,PO2
CO2	PO1,PO3
CO3	PO4,PO5
CO4	PO4,PO5
CO5	PO4,PO5,PO6
CO6	PO4,PO5,PO6,PO7

BMEO0003 SMART MATERIALS

Objective:

Studentswillbeabletounderstandthevarietyofsmartmaterials,theirapplicationandadvantages.Theywillalsolearn compositematerials,theirmanufacturingprocessesandtestingmethods.

Credits:04 L–T–P:3–1–0

ModuleNo.	Content	Teaching Hours
I	**Introduction:**ClassificationsofEngineeringMaterials,Conceptofcomposite materials, Matrix materials, Functions of a Matrix, DesiredPropertiesofaMatrix,PolymerMatrix(ThermosetsandThermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, GlassMatrixetc.TypesofReinforcements/Fibers:RoleandSelectionorreinforcement materials, Types of fibres, Glass fibers, Carbon fibers,Aramidfibers,Metalfibers,Aluminafibers,BoronFibers,Siliconcarbidefibers,Quartz andSilica fibers, Multiphasefibers,Whiskers,Flakes etc., Mechanical properties of fibres. Material properties that canbeimprovedbyformingacompositematerialanditsengineeringpotential **Various types of composites:** Classification based on Matrix Material:Organic Matrix composites, Polymer matrix composites (PMC), CarbonmatrixCompositesorCarbon-CarbonComposites,Metalmatrix composites(MMC),Ceramicmatrixcomposites(CMC);	23
II	Classification based on reinforcements: Fiber Reinforced Composites,FiberReinforcedPolymer(FRP)Composites,LaminarComposites,ParticulateComposites,ComparisonwithMetals,Advantages&limitationsof Composites **Fabricationmethods:**ProcessingofCompositeMaterials:Overallconsiderations, Autoclave curing, Other Manufacturing Processes likefilamentwelding,compressionmolding,resin-transplantmethod,pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrixperforms, Manufacturing Techniques: Tooling and Specialty materials,Releaseagents,Peelplies,releasefilmsandfabrics,Bleederandbreatherplies, baggingfilms **TestingofComposites:**Mechanicaltestingofcomposites,tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminarsheartesting, Fracture testingetc.	22

Text/ReferenceBooks:

- ThomasJ.BrunoandRyanDeacon,“Vol.10:Materialscharacterization”:ASMhandbook,2019.
- G.Dieter,“MechanicalMetallurgy”:Mc-GrawHillEducation,1961.
- R.E.SpeyerandMarcelDecker,“ThermalAnalysisofMaterials”:CRCPress,1993.
- A.KBhargava,“EngineeringMaterials:Polymers,CeramicsandComposites”:PrenticeHallofIndia, 2005.

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2*

Outcomes:

CO1:Understandingofsmartmaterials,manufacturingprocesses,advantagesandapplications.

CO2: Identify and Evaluate the properties of fiber reinforcements, particulates, matrix materialsandcommercialcomposites.

CO3:Developcompetencyinoneormorecommoncompositemanufacturingtechniques andbeabletoselectappropriatetechniqueformanufactureofcompositeproducts.

CO4: Analyze and understand the mechanical properties and mechanics of load transfer frommatrixtofibers.

CO5: Understand and predict the mechanical performance and failure behaviour of theComposites.

CO6:Apply theknowledgeofmanufacturingmethodsandcompositemechanicalperformanceofa given composites designproject.

CO7:To understandthedifferenttestingmethods/Characterizationofsmartmaterials.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs
CO1	PO1
CO2	PO1/PO4/PO5
CO3	PO1
CO4	PO1
CO5	PO1/PO4
CO6	PO1/PO2/PSO2
CO7	PO1/PSO2

BMEO0004 PROJECT MANAGEMENT

Objective: *The main objectives of project management are as follows: Understand exactly what a project ismeant to do and what it is meant to deliver. To learn the scope, timescales, cost and quality of a project. How tomaintain a schedule and project plan. To estimate the cost of project. Different finance institute available forfinancial add. Deliver the agreed outcomes of the project to the right scope, timescales, cost and quality. Providecommunications, reports and progress updates throughout the lifecycle of the project. To let students know howtomanagerisks, issuesand dependencies*

Credits:03 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Project Characteristics, Attributes of A Good Project Manager,TaxonomyofProjects. **ProjectIdentification&Formation:**ProjectIdentification,DemandForecasting, Project Preparation, Zero Based Project Formulation, PreliminaryProjectReport,Comparison ofProjectAlternatives. **Project Appraisal:** Technical Appraisal, Commercial Appraisal, EconomicalAppraisal, Management Appraisal, Social Cost Benefit Analysis, NPV, IRR, BCR,NBCR. **FinancingofProjects:**EstimationofCostComponentsofProjects.Sources of Finances, Role of Financial Institutions, Cash Inflow and Cash Outflow, Cost ofCapital.	20
II	**ProjectPlanning&Scheduling:**SchedulingTechniques,PERT&CPM,NetworkPreparation,UpdatingNetwork,LineofBalanceTechnique,PerformanceAnalysisofProjects,CostVsTimeofCompletion,NormalTimeand Crash Time, Resource Allocation Techniques, Work Breakdown Structure.**ProjectContracts:**TypesofContract,Sub-Contract,Tenders&TypesofPaymenttoContractors. **ComputerAidedProjectManagement:**EssentialRequirementsofSoftware's, Software Packages, Enterprise-Wide Project Management, SpreadSheets. ProjectOrganization,PostProjectEvaluation,ProjectSickness–Causes,Predictionof Causes,Rehabilitation,ProjectAudit,Risk Analysis.	20

TextBooks:

- NagarajanK.,*ProjectManagement*,NewAgeInternationalPublishers.
- PanneerselvamR.&SenthilkumarP.,*ProjectManagement*,PHILearning.

ReferenceBooks:

- PatelBhaveshM,*ProjectManagement*,VikasPublishingHome.
- ScelharamanS.&RamnathVijay,*ProjectManagement*,Breweries;Education.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:

Aftercompletionofthe course,studentwillbeableto:

CO1:UnderstandtheprojectcharacteristicsandTaxonomyofProject.

CO2:ApplytheknowledgeofDemandForecastinginmanagingthevariousprojects
CO3:UnderstandtheTechnical,Commercial,EconomicalandManagementAppraisal

CO4:Understandtheconceptofprojectnetwork,projectscheduleandprojectmonitoringactivities byusing CPMandPERTmethod.

CO5:proficientlyhandlethevarioussoftwarepackagesformanagingtheproject.

CO6: Determine the cost components of Projects and identify different Sources ofFinances

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program SpecificOutcomes(PSOs)

Cos	**POs**
CO1	**PO1**
CO2	**PO1,PO2,PO5,PO11**
CO3	**PO1,PO11**
CO4	**PO8,PO11,PO1**
CO5	**PO5,PO11**
CO6	**PO1,PO4**

BMEO0005 RELIABILITY AND MAINTENANCE ENGINEERING

Objective: *The objective of the course is to provide the students with the fundamental concepts, maintenanceworkload analysis and calculations, maintenance work scheduling the necessary knowledge and the basic skillsrelatedtosystemreliabilityand systemsmaintenancefunctions*

Credits:03 **L–T–P:3–1–0**

Module No.	Contents	Teaching Hours
I	Maintenance Management,Production Maintenance System, Objectives andFunctions, Forms, Policy, Planning, Organization, Economics of Maintenance,EvaluationofMaintenance Management. **MaintenanceStrategies:**BreakDownMaintenance,PreventiveMaintenance,PlannedMaintenance,MaintenanceProgramme,JobReport,Strategies. Design Out Maintenance, Planned Lubrication, Total Productive Maintenance,ZeroBreakDownManpowerPlanning,MaterialsPlanning,SpareParts PlanningandControl.	19
II	**ReliabilityEngineering:**Introduction,OperatingLifeCycle,Reliability,Failure Data Analysis, Failure Rate Curve, Hazard Models, Elements in Series,Parallel,Mix,LogicDiagrams,ImprovingReliability,Redundancy-Element,Unit,Standby,Maintainability,Availability,ReliabilityandMaintainabilityTradeOff. BreakDownMaintenancePlanning,ReplacementPlanningMaintainorReplaceDecision,ReplacementModels/Decisions,Individual,GroupReplacement, ReplacementinAnticipationofFailure. **ConditionMonitoring:**ObjectivesandTechniquesofConditionMonitoring.	21

TextBook:

- R. C. Mishra and K. Pathak, "*Maintenance Engineering & Management*": Prentice Hall of India, NewDelhi,2015.
- A. K. Gupta, "*Reliability Maintenance & Safety Engineering*": University Science, Press New Delhi,2009.

ReferenceBooks:

1. Dr.A.K.Gupta,"ReliabilityMaintenance&SafetyEngineering":UniversitySciencePressNewDelhi,2009.
2. KellyandM.J.Harris,"ManagementofIndustrialMaintenance":Boston:Newnes-Butterworths,1979.
3. B.S.Dhillon,"EngineeringMaintainability:HowtoDesignforReliabilityandEasyMaintenance":PrenticeHall ofIndia,New Delhi,1999.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Aftercompletionofcourse,the student willbe ableto:

CO1:Understandmaintenanceobjectivesandevaluatemaintenancestrategiesforprocessplantapplications.

CO2: Evaluate maintenanceschedules and assess the corresponding risks with appropriate tools&techniques.

CO3: Understand the concept of maintainability & availability and different techniques availableto improvemaintainability &availability.

CO4:Todevelopthetotaloptimumcostmodelforamaintenanceproblem.

CO5: Understand the concept of reliability & its techniques for estimating reliability andcharacteristicsofcomponents/systems.

CO6:Understandandapplytheconceptof reliabilitycentered maintenance(RCM) andadvantages for a company employing them.

CO7: Understand and apply the concept of condition monitoring techniques & its data for predictive maintenance.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs
CO1	PO1
CO2	PO1/PO5
CO3	PO1
CO4	PO3
CO5	PO4
CO6	PO6/PSO2
CO7	PO4

BMEO 0006 MECHATRONICS

Objective:*Mechatronicsisthecombinationofmechanicalandelectronicsautomationandcomputers.Nowadays all the mechanical machines have been made computer controlled. The Subject details the basichardware and software elements used for proper and successful operation of various equipment. The knowledgeofthissubjectwillbehelpfultostudentswhileworking inindustries.*

Credits:04 L–T–P:3–1–0

Module No.	Content	Teaching Hours
I	**Introduction:** Automated Manufacturing System, need of Automation, elementsofAutomation,levelsofAutomation,Automationstrategies,advantages&disadvantagesofAutomation,CAD/CAM,CIM,FMSand CNCsystem. **MechatronicsSystem:**ElementsofMechatronicssystem,levelsofMechatronicssystem,MechatronicsDesignProcess,SystemandControl,feedback Principle, real time Mechatronics system and application, advantagesanddisadvantagesof Mechatronicssystem. **MechanicalActuatingSystems:**Typesofmotion,Degreesoffreedom,constraints, Kinematic Chains, Cam, Gear and gear trains, Ratchet and pawl Beltdrive,chain drive,bearing,preloading. Hydraulic&PneumaticActuationSystems:Fluidpowersystems,hydraulicsystems, Pneumatic systems, system structure and signal flow, hydraulic pumpsandPressureControlValves,aircompressorsandtreatment,Cylinders, DirectionControlValves,RotaryActuators.	20
II	**Electrical Actuation Systems:** Switching Devices, Mechanical Switches – SPST,SPDT, DPDT, Relays, solenoid operating Valve, Solenoid Operated Hydraulic andPneumatic Valves, Open and Close loop control system, Control of DC Motors,PermanentMagnetDCMotors,brakingofDCMotors,ACMotors,StepperMotorsandControls. **Sensors, transducers and application:** Performance Terminology, Static andDynamicCharacteristics,Displacement,PositionandProximitySensors,PotentiometerSensors,LVDT,Optical Encoders, HallEffectSensors. **Programmablelogiccontrollers:** Programmablelogiccontrollers(PLC)Structure,Input/OutputProcessing,principlesofoperation,PLC versus computer, selectingaPLC. **Casestudies:**Mechatronicapproachtodesign,BoatAutopilot,highspeedtiltingtrain,automaticcarparksystem,coincounter,enginemanagementsystem,autonomous mobilesystem,antilockbrakesystemcontrol,UsingPLC for extending and retracting a pneumatic piston and two pneumatic pistons indifferent combinations.	24

TextBooks:

- W.Bolton,"Mechatronics–ElectroniccontrolsystemsinMechanical&ElectricalEngineering",PearsonEducationLtd., 2003.
- K.P.Ramachandran,G.K.Vijayaraghavan,M.S.Balasundaram,Mechatronics-IntegratedMechanicalElectronicSystems,Wiley;

ReferenceBooks:

- JojiP,PneumaticControls,Wiley.
- DanNecsulescu,Mechatronics,Pearson
- DavidgAlciatore,Michael B Histand,"IntroductiontoMechatronics and measurementsystems",McGraw Hill Education.

- ASmaili,FMrad,“Mechatronics–IntegratedTechnologiesfor Intelligent Machines,OxfordHigherEducation.
- NitaigourPremchandMahalik, “Mechatronics Principles, Concepts & Application”,TataMcGrawHillPublishing Co.Ltd., 2003.

Focus: This course focuses on Employability/Skill development and aligned with CO’s 1 and 2

Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs
CO1	PO1/PSO2
CO2	PO1/PO2/PO12
CO3	PO1/PSO2/PSO3
CO4	PO1/PO2/PO12
CO5	PO1/PSO2/PSO3
CO6	PO1/PO2/PO12
CO7	PO1/PO2/PO12

OPEN ELECTIVE

BMEO 0007: SIX SIGMA & APPLICATIONS

Objectives: *Study of this subject will enable the students to develop their mental horizon byenhancing their knowledge and skills which will embed organizational skill & it would be overallbeneficial for any organization. The main objective is to provide to the students its principles andproblems associates during implementation so that the students make a significant contribution to anorganizationby use itsapplications invarious areas.*

Credits: 04 **L-T-P:3-1-0**

Module No.	Contents	Teaching Hours
I	**Introduction:**Principlesofsix-sigma,Statisticalbasis,ToolsandTechniques,DMAICprinciple,6Sofsixsigma,Customerrequirements,Eliminationof wastes anddefects, Evolution of six sigma quality approach, Practical approach to six sigmaquality, Basic steps involved in the application of six sigma, TQM and sixsigma,Qualityimprovement,Sixsigma andother qualityinitiatives. **Project Management Applications**: Areas of six sigma and its approach, Six-sigmamanagement method, Integration of project management, Effectivemanagementofsix-sigmaprojectsanddisciplinedsix-sigmamethodinmanagingprojectsin organization. **Process Control Charts**: X & R charts, p & C charts, Limits calculations;Importance&Applications.	25
II	**LeanManufacturing**:Concept,goals,components,toolsandtechniques,JIT, KANBANsystem, wastereduction. **Organizational Structure of Six-sigma**: Gains made by the global six sigmastars,sixsigmaandIndianindustries,sixsigmaconceptofprocesscapability,OrganizationalStructure,Projectmethodology,QuadrupleConstraints ofprojectmanagement,Businesssystemsimprovement,Importanceofevaluating thesuccessofprojects,Importancecareerpathrequirements. **Factories of future**: Nature and categories of FOF, Zero bases FOF, Designandplanningforfuturisticfactories.	25

Text Books:

- TheSixSigmaHandbook: AComplete GuideforGreenBelts,BlackBelts, andManagersat AllLevelsThomas PyzdekPaulA. Keller,Mc GrawHill.
- Lean Six Sigma For Dummies, 2nd Edition Published by John Wiley & Sons, Ltd.,TheAtriumSouthern GateChichesterWestSussex PO19 8SQEngland.
- THE LEAN SIX SIGMA BLACK BELT HANDBOOK Tools and Methods for ProcessAccelerationFrankVoehl •H.James HarringtonChuckMignosa•Rich Charron,CRCPress

Reference Books:

- Skimmar,Wickham, Manufacturing in the corporate Strategy, John Wiley and sons,NewYork
- HearmBuckandButler, D.M.,Economic product Design, Colhins,London
- Cluttarbuck,JIT–AGlobal StatusReport,IFSpublications
- MichaelJ.Termini,Thenewmanufacturingengineer,Societyofmanufacture engineerMichigan,USA

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome:Attheendofthecoursethestudentwouldbeableto:

CO1: Explain complete range of topics starting from its basic idea to its applications in various areas.CO2: Describetools&techniques,eliminationofwastesandtheirreductioninpresent scenario.

CO3:Understandthathowtoanalysisthevariouscontrolchartsforprocessvariations.CO 4: ExplaintheconceptofLean manufacturingandits widescope.

CO5:UnderstandtheBusinesssystemsimprovement,Importanceofevaluatingthesuccessofprojects.

CO6: Understand theconceptofFactoryoffuture,Zero basesFOF.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs):

COs	POs
CO1	PO1,PO2, PO3
CO2	PO2,PO3
CO3	PO2,PO3
CO4	PO1,PO2
CO5	PO1
CO6	PO1,PO3

COURSE STRUCTURE & SYLLABUS

(w.e.f. Session 2018-19)

Ph.D.

(FULL TIME/PART TIME)

Department of Mechanical Engineering

COURSE STRUCTURE & SYLLABUS

CREDIT COURSES

COMPULSORY SUBJECT

PREC-0001 Research Methodology
PREC-0010 Research Publication & Ethics

DISCIPLINE / SPECIALIZATION SUBJECTS

Mechanical Engineering

(Any two of the following)

PME E-0001 Competitive Manufacturing Strategies and Group Technology
PME E-0002 Numerical Techniques and Soft Computing
PME E-0003 Metal Working Tribology
PME E-0004 Production Toolings
PME E-0005 Accuracy Inspection and Measurements
PME E-0006 Value Engineering & Cost Control
PME E-0007 Optimization Techniques
PME E-0008 Advanced Mechanics of Solids
PME E-0009 Nano Technology & its Applications
PME E-0010 Reliability & Maintenance
PME E-0011 Advanced Heat Transfer Processes
PME E-0012 Composite Materials & its Applications
PME E-0013 Advanced Welding Processes And Applications
PME E-0014 Industrial Automation and Robotics
PME E-0015 Industrial Tribology

DISCIPLINE / SPECIALIZATION SUBJECTS

PMEE-0001 COMPETETIVE MANUFACTURING STRATEGIE S AND GROUP TECHNOLOGY

Pre-requisite: *Manufacturing Science*

Objective: *The basic objective of the present course is to acquaint the participants with the conceptual framework and formulation different manufacturing strategies for competitive environment. and to understand the concept of value engineering, lean manufacturing, six sigma to improve effectiveness of the product and processes. Participants are able to identify and asses new technologies to design and planning of futuristic factories.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Manufacturing Strategy: Conceptual framework and competitive environment, manufacturing problems, Manufacturing Audit and strategy formulation, Diagnostic review and opportunity assessment Technological strategy: Strategic planning, product and process design for improved Manufacturability and producibility, identification and assessment of new technologies.	15
II	**Unit-II** Value Engineering: Concept of Value & function, reasons for unnecessary cost, methodology & techniques, acceptance problems, value engineering effectiveness, profit impact of value engineering, industrial and business applications. Lean Manufacturing: concept, goals, components, tools and techniques, JIT, KANBAN system, waste reduction.	15
III	**Unit-III** Cellular manufacturing and Group technology: Part family, part classification and grouping, classification and coding systems, benefits and economics of grouping, cell formation. Six sigma as manufacturing strategy: Concept, methodology and applications SIPOC analysis, focused manufacturing, agile manufacturing, intelligent manufacturing, digital manufacturing and factories of future.	15

Books/ References:

1. *Skimmar, Wickham, Manufacturing in the corporate Strategy, John Wiley and sons, New York.*
2. *Hearm Buck and Butler, D.M. "Economic product Design", Colhins, London.*
3. *Cluttarbuck, "JIT – A Global Status Report, IFS publications.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, Students will be able to:*

CO1: Formulate and review the manufacturing strategies for competitive environment;
CO2: Knowledge about Strategic planning, product and process design for improved Manufacturability and Producibility;
CO3: Knowledge about Value Engineering, methodology & techniques, acceptance problems, value engineering effectiveness, profit impact of value engineering, industrial and business applications;
CO4: Knowledge about the Lean Manufacturing, tools and techniques, JIT, KANBAN system, waste reduction;
CO5: Knowledge about the Six sigma, SIPOC analysis, focused manufacturing, agile manufacturing, intelligent manufacturing, digital manufacturing, rapid response manufacturing and customer satisfaction;
CO6: Factories of future: Nature and categories of FOF, Zero Bases FOF, Design and planning for futuristic

factories.

PMEE-0002 NUMERICAL TECHNIQUES AND SOFT-COMPUTING

Pre-requisite: *Computer based numerical techniques and soft computing*

Objective: *Conceptual understanding of mathematics, numerical analysis, statistics, computer and information sciences which underpin the engineering discipline.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Numerical Techniques: Interpolation & extrapolation, Finding roots of equation & optimization. Least-square-fitting. Laplace-Transform as (non-numerical) solution of differential equations. Numerical Differentiation and Integration, Solving Differential Equations numerically. FDM introduction & applications.	15
II	**Unit-II** Artificial Neural Network: Concept of Artificial-Neural-Network (ANN), supervised, unsupervised learning & reinforced learning, types of activation function. Back-propagation algorithm for ANN and possible applications	15
III	**Unit-III** Fuzzy set theory, Fuzzy relation, Operation on Fuzzy Relation, α-Cuts of Fuzzy Relation, Composition of Fuzzy Relations, Fuzzy Logic & Controller: Concept of Fuzzy-Logic, Fuzzy Inference System with Fuzzy Application. Basic concepts, working principle & procedures of Genetic Algorithm (GA), flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators Cross over - Mutation – Reproduction, Generational Cycle, Fitness Computations, applications.	15

Books/ References:

1. *Yaswant Kanetkar, Let us C, BPB Publications*
2. *Balaguruswamy, C++ with OOPs'*
3. *Rajaraman, Numerical Methods,*
4. *Kalyanmoy Deb, Optimization Methods, Prentice Hall of India*
5. *Rao & Rao, C++ Neural Network and Fuzzy Logic, BPB Publications*
6. *Rajasekaran and Vijayalakshmi Pai, Neural Network, Fuzzy Logic and Genetic Algorithm, PHI Learning*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the students will be able to:*

CO1: *Solve large systems of simultaneous linear equations. Find eigen values and eigenvectors of a matrix.*

CO2: *Use the least-squares method to obtain a function for data analysis.*

CO3: *Find solutions of non-linear equations using bisection method, Newton's methods and secant method and implement using a computer.*

CO4: *Estimate the solutions of systems of first order ordinary differential equations or higher order ordinary differential equations using various numerical methods and implement using a computer.*

CO5: *Learn about soft computing techniques and their applications. Analyze various neural network architectures. Understand perceptions and counter propagation networks. Define the fuzzy systems. Analyze the genetic algorithms and their applications.*

PMEE-0004 PRODUCTION TOOLINGS

Pre-requisite: *Machine Tool Design*

Objective: *To increase the production rate by designing tools that will produce parts as quickly as possible.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Jigs & Fixtures: Types and applications. Principle of design and constructions, Location and clamping. Design of turning, Milling, Drilling & Indexing Jigs and fixtures. Hydraulic, Pneumatic and pneumohydraulic devices for jigs and fixtures.	15
II	**Unit-II** Press Dies: Classification of dies, components of dies assembly, Simple dies, compound dies, combination dies and progressive dies. Punch and die clearance, centre of pressure, calculation of blank diameter. Design of cutting dies, forming dies and progressive dies. Dies for metal powder performs, design considerations, Basic models of flow & preform design.	15
III	**Unit-III** Cutting Tools: Design of tools for the production of holes, surfaces of revolution, and flat surfaces like single point tools, form tools, drills, milling cutters. Materials for cutting tools, cutting dies and forming dies, Economics of Tooling. Plastics as a tooling material.	15

Books / References:

1. *Production Engineering Design (Tool Design) Umesh Chandra & Surender Kumar, Satya Prakashan, New Delhi.*
2. *Tool Design by C. Donaldson G.H.Lecain and V.C. Goold, Tata McGraw Hill*
3. *Jigs & Fixtures Fred H. Colvin*
4. *Basic Die Making Osterguard E., Mc-Graw Hill Book Co.*
5. *Metal Cutting & Tool Design V. Arshinov, Mir Publication.*
6. *Properties and Selection of Tool Material Kortesoja, Victor A., ASM.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, students would be able to:*

CO1: The course intends to expose the students to the concept of Jig and Fixtures their principle of design and constructions with Locating and clamping.

CO2: Awareness of Hydraulic, Pneumatic and Pneumo-hydraulic devices used for Jig and Fixtures.

CO3: Knowledge of Press Dies, classification, components of die assembly,

CO4: Dies for metal powder performs, design consideration.

CO5: Awareness the knowledge of cutting Tools, Design of tools for the production of holes, surface of Revaluation.

CO6: Able to know the materials for cutting tools, cutting dies and forming dies and plastic as a tooling material.

PMEE-0005 ACCURACY, INSPECTION & MEASUREMENT

Pre-requisite: *Measurement & Metrology*

Objective: *To develop in students the knowledge of basics of Measurements, Metrology and Measuring devices.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Product and its elements, component parts and units, classification of units as assemblies and sub-assemblies, assembly flow charts – content and purpose. Concept of precision, accuracy and measurement, accuracy and manufacturing errors, control of process variability. Errors and their measurement, general characteristics of errors occurring in manufactured parts and assemblies, concept of dimension chain and its application.	15
II	**Unit-II** Manufacturing and assembly line practices, types of manufacturing process and their accuracy. Measurement system – calibration, uncertainty of measurement, traceability, repeatability and reproducibility, standards of measurement. Gauges, limits, fits and tolerances. Taylor's principle of gauging.	15
III	**Unit-III** Surface quality of workpieces, surface, surface microgeometry, effect of surface quality on the functional properties. Surface finish and its measurement. Application of sensor and transducer technology in measurement.	15

Books/References:

1. *W Grant and E L Grant. Handbook of Industrial Engineering and Management. Prentice Hall of India (P) Ltd. New Delhi.*
2. *R K Jain. Engineering Metrology. Khanna Publishers (P) Ltd., Delhi.*
3. *K J Hume. Engineering Metrology. McDonald & Co.*
4. *I C Gupta. Engineering Metrology. Dhanpat Rai & Sons, Delhi.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *At the end of this course students will be able to*

CO1: Understand the measurement systems, units and dimensions and characteristics of measuring instruments.
CO2: Explain the various form measurements like straightness, flatness, roundness.
CO3: Understand working of suitable instruments for typical measurements like strain, force and torque.
CO4: Identify methods and devices for measurement of length and angle.
CO5: Understand concepts of limits, fits and tolerances in industrial application.
CO6: Design of limit gauges.
CO7: Determine and measure of surface roughness.

PMEE-0006 VALUE ENGINEERING AND COST CONTROL

Pre-requisite: *Value Engineering*

Objective: *Understand the importance of value engineering and its application in their respective fields Familiarize with the procedure of Value analysis and Value engineering. Implementation of value engineering.*

Credits: 04

L–T–P: 3–1–0

Module No.	Contents	Teaching Hours
I	**Unit-I** Concept and utility milestones of VE value and function, value ratio, Value determination and value assessment, Reasons for poor value and unnecessary cost, major principles and commandants of VA/VE, leader thoughts in VE, Value analysis team, VE and standardization. Methodology and techniques used in VE/VA, waste and its elimination, procedural model and different phases, DARSIRI method, creative and judicial mind.	15
II	**Unit-II** Exchange process between customer and industry, product life cycle, modular products and size ranges, product profit planning, product improvement and development, product design for competitive advantage. Need analysis and generation of ideas preparation of specifications. Cost reduction and Cost control, Cost system, elements of cost, standard cost, calculation of selling price, total life cycle costing objectives and techniques of cost control creativity and brainstorming, requirements of creativity, process of creativity characteristics of creative people.	15
III	**Unit-III** VE as a decision support system, Acceptance problems, effectiveness measurement and profit impact of VE/VA. Applications in Industrial and Business operations, making VE projects more cost effective, design of worksheets for VE projects, situational case studies and industrial problems.	15

Books/ References:

1. *Iyer, K.S., "Value Engineering".*
2. *Kumar S. and Agrawal A., "Value Engineering & Cost Control", Dhanpat Rai & Co., New Delhi.*
3. *R.S. Dwivedi – Research Methodology in Behavioural Science, McMillan India Ltd. New Delhi, 2005.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *After completion of the course, student will be able to:*

CO1: To impart knowledge in concepts and tools of Value Engineering.

CO2: Apply the knowledge & tools of Value Engineering in industries.

CO3: Understand the Different phases of value engineering and their sequence.

CO4: Understand and apply the methods of job planning.

CO5: Analyze the product design & development by applying concept of value engineering.

PMEE-0007 OPTIMIZATION TECHNIQUES

Pre-requisite: *Optimization for Engineering Design*

Objective: *To introduce the fundamental concepts of optimization techniques and to make the learners aware of the importance of optimizations in real scenarios.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **Introduction:** Introduction to optimization, Classical Optimization techniques, unconstrained optimization, constrained optimization. **Interpolation and Approximation:** Lagrange's and Newton-divided difference formula, Newton interpolation formula for finite differences, Gauss's forward and backward interpolation formula, Stirling's and Bessel's formula, Curve fitting-Method of Least squares. **Numerical Differentiation and Integration**: Numerical differentiation using different operators, Trapazoidal rule, Simpon's 1/3 and 3/8 rules, Boole's rule and Weddle's rule.	15
II	**Unit-II** **Solution of algebraic and transcendental Equation:** Newton-Raphson method, Bisection method, False-Position method and Graeffe's root square method. **Solution of Linear simultaneous Equations:** Cholesky's (Crout's) method, Gauss elimination method, Gauss-Seidel iteration and relaxation method. **Finite Element Method (FEM):** Introduction and Applications of FEM.	15
III	**Unit-III** **Artificial Neural Network (ANN):** Concept of Artificial Neural Network (ANN) supervised & unsupervised learning. Back propagation algorithm (computer program) for ANN and possible applications. **Fuzzy Logic**: Concept of fuzzy logic. **Non-Traditional Optimization (Genetic-Algorithm and simulated-Annealing):** Introduction to global optimization techniques such as Genetic-Algorithm (GA) and Simulated-Annealing.	15

Books/References:

1. *'Engineering Optimization' by S.S. Rao, New Age publishers*
2. *'Numerical Methods by B.S. Grewal, Khanna Publications*
3. *'Numerical Methods by A.D. Booth, Academic Press, NY*
4. *'Numerical Methods for Engineers' by S.K. Gupta, Willy Eastern Ltd.*
5. *'Neural Network, Fuzzy Logic and Genetic Algorithm' by Rajasekaran and Vijayalakshmi pai, PHI Learning.*
6. *'C++ Neural Network and Fuzzy Logic', by Rao and Rao, BPB Publications.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the students will be able to:*

CO1: Formulate optimization problems.
CO2: Understand and apply the concept of optimality criteria for various type of optimization problems.
CO3: Solve various constrained and unconstrained problems in single variable as well as multivariable.
CO4: Apply the methods of optimization in real life situation.
CO5: To apply knowledge of basic mathematics to calculate the machining parameters for different

machining processes.

CO6: To implement different methods of optimization on the data obtained through machining process.

PMEE-0008 ADVANCED MECHANICS OF SOLIDS

Pre-requisite: *Strength of Materials*

Objective: *The objective of the course is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** Analysis of 3-dimesional stress and strain, Constitutive relationships, failure theories, Torsion of non-circular sections, Plane stress and plain strain problems, Fatigue analysis, Introduction to fracture mechanics.	15
II	**Unit-II** Inelastic behaviour, Viscoelasticity, Structure and behaviour of polymers, Composites and their applications, Behaviour of unidirectional composites and orthotropic lamina, Failure theories for fibre composites, development of various structures in composites.	15
III	**Unit-III** Theory of laminates, Photoelasticity in experimental stress analysis, Computer based analysis and solutions to problems in mechanics of solids.	15

Text Books:

1. *A I Lurie, Theory of Elasticity (Foundations of Engineering Mechanics)*
2. *T.L. Anderson, Fracture Mechanics: Fundamentals and Applications, CRC Press*
3. *Dowling, Norman E, Mechanical Behaviour of Materials: Engineering Methods for Deformation, fracture and Fatigue, Prentice Hall.*
4. *E.P. Popov, Engineering Mechanics of Solids, Prentice Hall of India*

Reference Books:

1. *AK Singh, Mechanics of Solids, Prentice Hall of India*
2. *Kanninen, Melvin F, Popelar, Carl H and C.H. Popelar, Advanced Fracture Mechanics, Oxford University*
3. *Isaac M. Daniel Ori Ishai, Engineering Mechanics of Composite Materials, Oxford University*
4. *Jones R.M., Mechanics of Composite Materials, Technomic Publishing Company*
5. *Ronald F. Gibson, Mechanics of Composite Materials, Mc-Graw Hill*
6. *Madhujit Mukhopadhyay, Mechanics of Composite Materials, Universities Press*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *After successful completion of this course, the student will be able to:*

CO 1: Elementary understanding of the concepts of stress and strain in mechanics of solids and structures and material properties.

CO 2: Apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force-deformation, and stress-strain relationships to the solid and structural mechanics problems.

CO 3: Analyze determinate and indeterminate bars, beams, and determinate trusses to determine axial forces, torques, shear forces, and bending moments.

CO 4: Physical insight into inelastic behavior of composites, failure theories of fiber composites and development of various structures in composites.

CO 5: Basic understanding of theory of laminates, computer based analysis and solutions to problems in mechanics of solids.

PMEE-0009 NANOTECHNOLOGY AND ITS APPLICATIONS

Pre-requisite: *Material Science*
Objective: *To understand the concept of nanotechnology and their applications in recent industrial applications.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** The nanoscale dimension and paradigm, Definitions, history and current practice, structure, size dependence of properties, crystal structures, face centered cubic Nano particles, Lattice vibrations, methods of measuring properties atomic structures, crystallography, particle size, determination, surface structures. Transmission electron microscopy, field ion microscopy, scanning microscopy, infrared and Raman spectroscopy, photoemission and x-ray spectroscopy, magnetic resonance. Overview of current industry applications, Nanoscale science and engineering principles, Engineering principles for nanotechnology materials and applications.	15
II	**Unit-II** Carbon Nanotube Technologies (CNT), From graphite to buckyballs to CNT, Carbon nanotube applications and multi-walled carbon nano-tubes (MWCNT), Fabricating carbon nanotubes and nano-wall structures, Key applications of CNT and MWCNT, Nanolithography, Thin film processes, Imaging using scanning electron micro-scope (SEM), SPM-AFM, Traditional surface and materials analysis techniques, Molecular manufacturing, Self-assembly and 'bottom-up' manufacturing, Thin film applications, Thin film deposition processes, Applications in thin film deposition.	15
III	**Unit-III** Quantum well, wires and dots- Introduction, preparation of quantum nanostructures, size and dimensionality effects, potential wells, nanomachines and nanodevices, micro electro mechanical systems (MEMS), Nanoelectromechanical systems (NEMS).	15

Text Books:

1. *Charles P, Poole Jr. and Owens, Introduction to Nano technology, Wiley Interscience*
2. *Bharat Bhushan, Springer Handbook of Nanotechnology, Springer*

Reference Books:

1. *Mark A Ratner, Nanotechnology a gentle introduction to the next big idea, Pearson Education and Company*
2. *H.F.Tibbalas, Introduction to nano science and nanotechnology, CRC Press*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *After successful completion of this course, the student will be able to:*

CO1: Understand about types of nanomaterials

CO2: Determine aspects ratio of nanomaterials

CO3: Understand characterization techniques required for various types of nanomaterials.

CO4: Perform physical and chemical analysis of nanomaterials

CO5: Understand various techniques of nano-material formation.

PMEE-00010 RELIABILITY & MAINTENANCE

Pre-requisite: *Reliability & Maintenance Engineering*
Objective: *To develop the understanding of reliability and maintenance engineering and solve the issues in real industrial applications.*

Credits: 04 L–T–P: 3–1–0

Module No.	Contents	Teaching Hours
I	**Reliability Engineering:** System reliability - series, parallel and mixed configurations, block diagram, r-out-of-n structure. Reliability improvement and allocation-Difficulty in achieving reliability, method of improving reliability during design, different techniques available to improve reliability, Reliability – Cost trade off, Prediction and analysis. Maintainability & Availability: Maintainability & Availability –Techniques available to improve maintainability & availability, trade off among reliability, maintainability & availability, simple problems.	15
II	**Maintenance Planning and Replacement:** Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Replacement decisions, – group replacement. Failure Analysis: Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis.	15
III	**Maintenance Systems:** Fixed time maintenance, Condition based maintenance, Operate to failure, Opportunity maintenance, design out maintenance, Total productive maintenance, Concept of terrotechnology. Condition Monitoring and Diagnostics: Levels of condition monitoring, Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, noise and sound monitoring, Frequency of condition monitoring.	15

Text Books:
1. *L.S. Srinath, Concepts in Reliability Engineering, Affiliated East West Press*
2. *R.C. Mishra & K. Pathak, Maintenance Engineering & Management, Prentice Hall of India, New Delhi*
3. *S.K. Srivastava, Industrial Maintenance Management, S. Chand & Co Ltd.*

Reference Books:
1. *Dr. A.K. Gupta, Reliability Maintenance & Safety Engineering, University Science Press New Delhi*
2. *Kelly and M.J. Harris, Management of Industrial Maintenance, Butterworth and Co.*
3. *B.S. Dhillon, Engineering Maintainability: How to Design for Reliability and Easy Maintenance, Prentice Hall of India, New Delhi.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *After completion of course, the student will be able to:*
- *CO1: Understand maintenance objectives and evaluate maintenance strategies for process plant applications.*
- *CO2: Evaluate maintenance schedules and assess the corresponding risks with appropriate tools & techniques.*
- *CO3: Understand the concept of maintainability & availability and different techniques available to improve maintainability & availability.*
- *CO4: To develop the total optimum cost model for a maintenance problem.*
- *CO5: Understand the concept of reliability & its techniques for estimating reliability and characteristics of components/systems.*

CO6: Understand and apply the concept of reliability centered maintenance (RCM) and advantages for a company employing them.

CO7: Understand and apply the concept of condition monitoring techniques & its data for predictive maintenance.

PME E0011 ADVANCED HEAT TRANSFER PROCESSES

Pre-requisite: *Heat & Mass Transfer*
Objective: *To develop the understanding of heat transfer mechanisms and solve the thermal issues in real life applications.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	Thermal conductivity and thermal diffusivity of materials. Thermo physical properties of nanofluids. Steady and Transient state heat transfer problems, finite difference formulation for different coordinates under various boundary conditions.	15
II	Heat exchanger heat transfer problems. Electronics cooling. Empirical correlations for heat exchangers. Nanofluids application in heat exchangers. Heat transfer mechanisms responsible for change in thermal performance. Convective mass transfer equations and their applications.	15
III	Heat Transfer by Radiation. Thermal Insulations. Boiling and Condensation, nucleate pool boiling and empirical correlations for pool boiling heat transfer, factors affecting pool boiling film coefficients, high heat flux boiling.	15

Reference Books:

1. *Principles of Heat and Mass Transfer by Frank P. Incropera, David P. Hawitt, TL Bergman, AS Lavine, Wiley publications.*
2. *Heat Transfer by J.P. Holman Mac-Graw Hills publication.*
3. *Heat and Mass Transfer- Fundamentals & applications by Yunus A. Cengel, Afshin J. Ghajar - Mac-Graw Hills publication.*

Outcome: *The ability to solve the heat transfer problems occurred in thermal management of the systems.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcomes: *After completion of course, the students will be able to:*

CO 1: Determine the heat transfer through composite wall of a Furnace under given boundary conditions.
CO 2: Determine the numerical heat transfer of composite system under steady state condition of heat transfer.
CO 3: Determine the numerical heat transfer of composite system under un-steady state condition of heat transfer.
CO 4: Establish empirical relation for a given heat transfer application.
CO 5: Understand mass diffusion rate in case of evaporative cooling in cooling towers.

PME E0012 COMPOSITE MATERIALS & ITS APPLICATIONS

Pre-requisite: *Material Science*

Objective: *The objective for this course is to develop knowledge of various types of composites, as well as an understanding of the dependence of their behaviors on the characteristics, relative amounts, geometry/distribution, and properties of the constituent phases.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Composite Materials & its classification:** Natural/Green composites, Classification of composites and their advantages. **Reinforcements:** Glass, boron, carbon, organic and ceramic fibers, their structure, properties and processing. **Particulates:** Properties and application of SiC, Al2O3, Si3N4 and TiC particulates. **Matrix Materials:** Polymer, metal and ceramic matrices, their structure, properties and processing. Wettability and interface bonding.	14
II	**Polymer Matrix Composites:** Glass Fiber Reinforced polymer (GFRP) Composites, Carbon Fiber Reinforced Polymer (CFRP) Composites, Aramid Fiber-Reinforced Polymer (AFRP) Composites, **Metal Matrix Composites:** Processing techniques and applications. **Ceramic Matrix Composites:** Processing techniques and applications. Carbon-Carbon Composites, Hybrid Composites	12
III	**Micromechanics:** Mechanical properties, thermal properties and load transfer. **Macromechanics:** Elastic behavior, Fracture, fatigue and creep behaviour of composites, Tribological behaviour of composites. Degradation of composites due to various environmental conditions and corrosion resistance of composites. Designing with composites, Engineering applications of composites.	14

Text Book:

1. *S.W. Tsai and H.T. Hahn, "Introduction to Composite Materials", Technomic Publishing Co.*
2. *A.K. Kaw, "Mechanics of composite materials", CRC Press.*
3. *Mukhopadhyay Madhujit, "Mechanics of Composite Materials and Structures", University Press.*

Reference Books:

1. *Rober M. Joness, "Mechanics of Composite Materials", Mc-Graw Hill Kogakusha Ltd.*
2. *Michael W, "Stress Analysis of Fiber Reinforced Composite Materials", Hyer MGH International.*
3. *Krishan K. Chawla, "Composite Material Science and Engineering", Springer.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *After successful completion of this course, the student will be able to:*

CO 1: Understand the types and properties of composites used in engineering.
CO 2: Understand the processing and fabrication of green & structural composites.
CO3: To compute longitudinal strength for discontinuous and aligned fibrous composite materials.
CO 4: To determine the longitudinal modulus and longitudinal strength for an aligned and continuous fiber reinforced composites.

PME E0013 ADVANCED WELDING PROCESSES AND APPLICATIONS

Pre-requisite: *Welding Science & Technology*

Objective: *To learn various concepts related to welding, its application and to have practical purview of various welding processes, welding standards, advanced welding process.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Physics of welding arc:** Characteristics of arc and mode of metal transfer, welding fluxes and coatings - type and classification; electrode codes and their critical evaluation. **Weldability of Materials** Weldability of cast iron, plain carbon and low alloy and stainless steels.	14
II	**Welding machine characteristics** - conventional and pulsed power sources, Inverter type, power sources for resistance welding. **Welding Processes:** Shielded Metal Arc Welding (SMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electrogas and Electroslag, Flux Cored Arc Welding, Resistance welding, Friction welding, Friction Stir Welding.	12
III	**Automated welding systems:** Microprocessor control of arc welding and resistance welding, quality assurance in welding, welding fumes and their effect on the environment. **Modern welding processes**: EBW, LBW, under water Welding, Ultrasonic welding, welding of ceramics, plastics and Composites.	14

Text Book:

1. *S.W. Tsai and H.T. Hahn, "Introduction to Composite Materials", Technomic Publishing Co.*
2. *A.K. Kaw, "Mechanics of composite materials", CRC Press.*
3. *Mukhopadhyay Madhujit, "Mechanics of Composite Materials and Structures", University Press.*

Reference Books:

1. *Dr. R.S. Parmar "Welding processes and technology" Khanna Publishers*
2. *Welding technology, R. Bittle, TMH*
3. *American society for metals, metal hand book vol.6*
4. *Welding process technology-Houldcraft PT-cambridge univ. press*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *After successful completion of this course, the student will be able to:*

CO1: The student will be able to understand the fundamental principles of welding processes.
CO2: The student will be able to ascertain the key parameters of each process,
CO3: The student will be able to Predict the material behavior upon welding,
CO4: The student will able to Design appropriate Pre and post welding Heat treatments (PWHT).
CO5: The student will able to understand Inspection/testing of welds, Procedure Specification & Procedure Qualification Record etc.

PMEE-0014 INDUSTRIAL AUTOMATION AND ROBOTICS

Pre-requisite: *Industrial Automation & Control Systems*

Objective: *Introduction to the concept of industrial automation, scope of automation and study of socio-economic effects. Introduction to the fluid power control and study of the different fluid power systems working.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **Introduction to Automation:** Mechanization and automation, Types of automation, Automation strategies, Hard Automation and Soft Automation, Economics of automation, Socio economic aspects of automation. Manufacturing Automation: Classification and types of Manufacturing Automation, Scenario of Automation and Factory Configuration, Shop Floor Control, MAP/TOP, AS/RS. AGV- Components Functions and Benefits, Traffic Controls and Safety, Cost Justification and Applications.	15
II	**Unit-II** **Robotics:** Robotic technology and applications, Laws of robotics, Robot systems and anatomy, Robot classification, Physical Configuration and Work Volume, Robotic Motions, Functional Parameters, revolution accuracy and repeatability, End Effectors, Robot kinematics, Homogeneous transformation, Direct and inverse kinematics, Manipulator motions, Robot drives, actuators and control, Robot motion and path planning control and Controllers, Robotic sensors and Robot vision, Image representation, Image recognition approaches.	15
III	**Unit-III** **Robot Applications:** Robot Capabilities, Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference, Economics and social aspects of robotics, Future applications. Implementation Principles, Maintenance & Safety, Robotic Education.	15

Text Books:

1. *Groover, Automation, Production System & Computer Integrated Manufacturing, Prentice Hall India*
2. *K.S. Fu, R.C. Gonzalez, C.S.G. Lee, Robotics, McGraw Hill.*

Reference Books:

1. *J.J. Craig, Robotics, Addison-Wesely*
2. *R.D. Klafter, t.a. Chmielewski and M. Negin, Robot Engineering: An Integrated Approach, Prentice Hall India.*
3. *Matthew t. mason, Mechanics of robotic manipulation, Prentice hall of india, 2005*
4. *Kumar Surender, "Industrial Robots and Computer Integrated Manufacturing", Oxford & IBH Publishing Co., New Delhi.*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, students would be able to:*

CO1: Knowledge regarding key components and functioning of an automated industry;

CO2: Knowledge regarding the working of elements such as hydraulic generator, hydraulic & pneumatic actuator hydraulic & pneumatic valves used in heavy construction equipments;

CO3: Knowledge regarding the methods used to handle the materials in automated industry, such as AGV's;

CO4: Basic knowledge about the Robotics and its technology, Robotics Laws, Classification, Functional Parameters;

CO5: Knowledge about the work volume and physical configuration of various Robots;

CO6: Knowledge regarding the, its vision system, its kinematics, Robot drives and ultimately the applications in various areas.

PME E0015 INDUSTRIAL TRIBOLOGY

Pre-requisite: *Fluid Mechanics*
Objective: *To learn various concepts related to life-cycle and production-cycle issues in all industrial sectors through the implementation of novel materials and new technologies.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit I** Basic concepts, Definition and scope of tribology in engineering applications. Friction: Material properties influencing friction, Laws of friction, Causes/theories of friction, Friction vis-à-vis material, Types of friction, Elastic and visco-elastic effects in friction, Effects of friction. **Wear**: Causes/sources of wear, Types of wear (adhesive, abrasive, corrosive, erosive, fretting), Wear of polymers, Wear of ceramic materials, Effects of wear, Steps for wear prevention/resistance. **Lubrication:** Purpose of lubrication, Lubrication principles/types, Properties and characteristics of lubricants, Types of lubricants (oils, greases, solid lubricants), Lubrication systems, Hydraulic oils.	23
II	**Unit II** Behaviour of Tribological Components: Selection, friction, wear, failures and lubrication aspects of bearings (rolling contact & plain), gears, wire-ropes, seals, conveyors etc. Objective and monitoring strategies for machine diagnostics. Fluid-Film Bearings: Fundamentals of Viscous Flow, Reynolds Equation and Application, Thrust Bearings, Journal Bearings, Squeeze-Film Bearings, Hydrostatic Bearings, Hybrid Bearings	22

Text Books:

1. *Harish Hirani, Fundamentals of Engineering Tribology with Applications, CAMBRIDGE University press, 2016*
2. *Emad Omrani, Pradeep K. Rohatgi, Pradeep L. Menezes, Tribology and Applications of Self-Lubricating Materials, CRC Press, 2018*

Reference Books:

1. *John A. Schey, Tribology in Metal Working, ASME, OMIO, 1983*
2. *Sushil Kumar Srivastava, Tribology in Industries, S. Chand, 2011*
3. *W.B. Rowe, Hydrostatic and Hybrid Bearing Design, Butterworths, 1st Edition 1983*

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the students will be able to:*

CO1: Formulate tribology based problems.
CO2: Understand and apply the concept of tribology criteria for various type of industrial problems, including SME company problems.
CO3: To have a mastery of the friction/lubrication mechanisms and know how to apply them to the practical engineering problem.
CO4: To know the methods to reduce the friction for several mating surfaces.
CO5: To have a practical exposure on the fluid film bearing, applications of Reynold's Equation, Thrust Bearings, Journal Bearings, Squeeze-Film Bearings, Hydrostatic Bearings, Hybrid Bearings.