INDEX

B. PHARM.
COURSE CURRICULUM
(W.E.F 2020-21)

INSTITUTE OF
PHARMACEUTICAL RESEARCH

Table-I: Course of study for semester I

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP101T	Human Anatomy and Physiology I– Theory	3	1	4
BP102T	Pharmaceutical Analysis I – Theory	3	1	4
BP103T	Pharmaceutics I – Theory	3	1	4
BP104T	Pharmaceutical Inorganic Chemistry – Theory	3	1	4
BP105T	Communication skills – Theory *	2	-	2
BP106RBT BP106RMT	Remedial Biology/ Remedial Mathematics – Theory*	2	-	2
BP107P	Human Anatomy and Physiology – Practical	4	-	2
BP108P	Pharmaceutical Analysis I – Practical	4	-	2
BP109P	Pharmaceutics I – Practical	4	-	2
BP110P	Pharmaceutical Inorganic Chemistry – Practical	4	-	2
BP111P	Communication skills – Practical*	2	-	1
BP112RBP	Remedial Biology – Practical*	2	-	1
	Total	**32/34$/36#**	**4**	**27/29$/30#**

#Applicable ONLY for the students who have studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB)course**.**

$Applicable ONLY for the students who have studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM)course**.**

* Non University Examination (NUE)

Table-II: Course of study for semester II

Course Code	Name of the course	No. of hours	Tutorial	Credit points
BP201T	Human Anatomy and Physiology II – Theory	3	1	4
BP202T	Pharmaceutical Organic Chemistry I – Theory	3	1	4
BP203T	Biochemistry – Theory	3	1	4
BP204T	Pathophysiology – Theory	3	1	4
BP205T	Computer Applications in Pharmacy – Theory *	3	-	3
BP206T	Environmental sciences – Theory *	3	-	3
BP207P	Human Anatomy and Physiology II –Practical	4	-	2
BP208P	Pharmaceutical Organic Chemistry I– Practical	4	-	2
BP209P	Biochemistry – Practical	4	-	2
BP210P	Computer Applications in Pharmacy – Practical*	2	-	1
	Total	**32**	**4**	**29**

*****Non University Examination (NUE)

Table-III: Course of study for semester III

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP301T	Pharmaceutical Organic Chemistry II – Theory	3	1	4
BP302T	Physical Pharmaceutics I – Theory	3	1	4
BP303T	Pharmaceutical Microbiology – Theory	3	1	4
BP304T	Pharmaceutical Engineering – Theory	3	1	4
BP305P	Pharmaceutical Organic Chemistry II – Practical	4	-	2
BP306P	Physical Pharmaceutics I – Practical	4	-	2
BP307P	Pharmaceutical Microbiology – Practical	4	-	2
BP 308P	Pharmaceutical Engineering –Practical	4	-	2
	Total	**28**	**4**	**24**

Table-IV: Course of study for semester IV

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP401T	Pharmaceutical Organic Chemistry III– Theory	3	1	4
BP402T	Medicinal Chemistry I – Theory	3	1	4
BP403T	Physical Pharmaceutics II – Theory	3	1	4
BP404T	Pharmacology I – Theory	3	1	4
BP405T	Pharmacognosy and Phytochemistry I– Theory	3	1	4
BP406P	Medicinal Chemistry I – Practical	4	-	2
BP407P	Physical Pharmaceutics II – Practical	4		2
BP408P	Pharmacology I – Practical	4	-	2
BP409P	Pharmacognosy and Phytochemistry I – Practical	4	-	2
	Total	**31**	**5**	**28**

Table-V: Course of study for semester V

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP501T	Medicinal Chemistry II – Theory	3	1	4
BP502T	Formulative Pharmacy– Theory	3	1	4
BP503T	Pharmacology II – Theory	3	1	4
BP504T	Pharmacognosy and Phytochemistry II– Theory	3	1	4
BP505T	Pharmaceutical Jurisprudence – Theory	3	1	4
BP506P	Formulative Pharmacy – Practical	4	-	2
BP507P	Pharmacology II – Practical	4	-	2
BP508P	Pharmacognosy and Phytochemistry II – Practical	4	-	2
	Total	**27**	**5**	**26**

Table-VI: Course of study for semester VI

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP601T	Medicinal Chemistry III – Theory	3	1	4
BP602T	Pharmacology III – Theory	3	1	4
BP603T	Herbal Drug Technology – Theory	3	1	4
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	3	1	4
BP605T	Pharmaceutical Biotechnology – Theory	3	1	4
BP606T	Quality Assurance –Theory	3	1	4
BP607P	Medicinal chemistry III – Practical	4	-	2
BP608P	Pharmacology III – Practical	4	-	2
BP609P	Herbal Drug Technology – Practical	4	-	2
	Total	**30**	**6**	**30**

Table-VII: Course of study for semester VII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP701T	Instrumental Methods of Analysis – Theory	3	1	4
BP702T	Industrial Pharmacy – Theory	3	1	4
BP703T	Pharmacy Practice – Theory	3	1	4
BP704T	Novel Drug Delivery System – Theory	3	1	4
BP705P	Instrumental Methods of Analysis – Practical	4	-	2
BP706PS	Practice School*	12	-	6
	Total	**28**	**5**	**24**

* Non University Examination (NUE)

Table-VIII: Course of study for semester VIII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP801T	Biostatistics and Research Methodology	3	1	4
BP802T	Social and Preventive Pharmacy	3	1	4
BP803ET	Pharmaceutical Marketing	3 + 3 = 6	1 + 1 = 2	4 + 4 = 8
BP804ET	Pharmaceutical Regulatory Science			
BP805ET	Pharmacovigilance			
BP806ET	Quality Control and Standardizations of Herbals			
BP807ET	Computer Aided Drug Design			
BP808ET	Cell and Molecular Biology			
BP809ET	Cosmetic Science			
BP810ET	Experimental Pharmacology			
BP811ET	Advanced Instrumentation Techniques			
BP812PW	Project Work	12	-	6
	Total	**24**	**4**	**22**

M. PHARM.
COURSE CURRICULUM
(W.E.F 2020-21)

INSTITUTE OF
PHARMACEUTICAL RESEARCH

Table 1: M. Pharm (Pharmaceutics)

Course Code	Course	Credit Hours	Credit Points	Hrs./wk	Marks
Semester I					
MPH101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPH102T	Drug Delivery System	4	4	4	100
MPH103T	Modern Pharmaceutics	4	4	4	100
MPH104T	Regulatory Affair	4	4	4	100
MPH105P	Pharmaceutics Practical I	12	6	12	150
-	Seminar/Assignment	7	4	7	100
Total		35	26	35	650
Semester II					
MPH201T	Molecular Pharmaceutics (Nano Tech and Targeted DDS)	4	4	4	100
MPH202T	Advanced Biopharmaceutics & Pharmacokinetics	4	4	4	100
MPH203T	Computer Aided Drug Delivery System	4	4	4	100
MPH204T	Cosmetic and Cosmeceuticals	4	4	4	100
MPH205P	Pharmaceutics Practical II	12	6	12	150
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Table 3: M. Pharm (Pharmaceutics and Pharmacology)
Common to Both Branches

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM 302T	Journal club	1	1
MRM 303T	Discussion / Presentation (Proposal Presentation)	2	2
-	Research Work	28	14
Total		35	21

* Non University Exam

M. Pharm (Pharmaceutics)

PHARMACEUTICS(MPH)

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES
(MPH 101T)

Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know,

- Chemicals and Excipients
- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

THEORY 60 HOURS

1. a. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy. — 11 Hrs

   b. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier – Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy

   c. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

   d. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

2 NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. — 11 Hrs

3	Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy	11 Hrs
4	Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography	11 Hrs
5	a. Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing b. X ray Crystallography: Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.	11 Hrs
6	Immunological assays : RIA (Radio immuno assay), ELISA, Bioluminescence assays.	5 Hrs

REFERENCES

1. Spectrometric Identification of Organic compounds – Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis – Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy – William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation – P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis– Modern methods – Part B – J W Munson, Volume 11, Marcel Dekker Series

DRUG DELIVERY SYSTEMS
(MPH 102T)

SCOPE

This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

OBJECTIVES

Upon completion of the course, student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of delivering system
- The formulation and evaluation of Novel drug delivery systems..

THEORY 60 Hrs

1.	Sustained Release(SR) and Controlled Release (CR) formulations: Introduction & basic concepts, advantages/ disadvantages, factors influencing, Physicochemical & biological approaches for SR/CR formulation, Mechanism of Drug Delivery from SR/CR formulation. Polymers: introduction, definition, classification, properties and application Dosage Forms for Personalized Medicine: Introduction, Definition, Pharmacogenetics, Categories of Patients for Personalized Medicines: Customized drug delivery systems, Bioelectronic Medicines, 3D printing of pharmaceuticals, Telepharmacy.	10 Hrs
2	Rate Controlled Drug Delivery Systems: Principles & Fundamentals, Types, Activation; Modulated Drug Delivery Systems;Mechanically activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems Feedback regulated Drug Delivery Systems; Principles & Fundamentals.	10 Hrs
3	Gastro-Retentive Drug Delivery Systems: Principle, concepts advantages and disadvantages, Modulation of GI transit time approaches to extend GI transit. Buccal Drug Delivery Systems: Principle of muco adhesion, advantages and disadvantages, Mechanism of drug permeation, Methods of formulation and its evaluations.	10 Hrs
4	Occular Drug Delivery Systems: Barriers of drug permeation, Methods to overcome barriers.	06 Hrs

5	Transdermal Drug Delivery Systems: Structure of skin and barriers, Penetration enhancers, Transdermal Drug Delivery Systems, Formulation and evaluation.	10 Hrs
6	Protein and Peptide Delivery: Barriers for protein delivery. Formulation and Evaluation of delivery systems of proteins and other macromolecules.	08 Hrs
7	Vaccine delivery systems: Vaccines, uptake of antigens, single shot vaccines, mucosal and transdermal delivery of vaccines.	06 Hrs

REFERENCES

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded,
Marcel Dekker, Inc., New York, 1992.

2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker,Inc., New York, 1992.

3. Encyclopedia of controlled delivery, Editor- Edith Mathiowitz, Published by WileyInterscience Publication, John Wiley and Sons, Inc, New York! Chichester/Weinheim

4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).

5. S.P.Vyas and R.K.Khar, Controlled Drug Delivery – concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002

JOURNALS

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian drugs (IDMA)
3. Journal of controlled release (Elsevier Sciences) desirable
4. Drug Development and Industrial Pharmacy (Marcel & Decker) desirable

MODERN PHARMACEUTICS
(MPH 103T)

Scope

Course designed to impart advanced knowledge and skills required to learn various aspects and concepts at pharmaceutical industries

Objectives

Upon completion of the course, student shall be able to understand

- The elements of preformulation studies.
- The Active Pharmaceutical Ingredients and Generic drug Product development
- Industrial Management and GMP Considerations.
- Optimization Techniques & Pilot Plant Scale Up Techniques
- Stability Testing, sterilization process & packaging of dosage forms.

THEORY 60 HRS

1. a. Preformation Concepts – Drug Excipient interactions – different methods, kinetics of stability, Stability testing. Theories of dispersion and pharmaceutical Dispersion (Emulsion and Suspension, SMEDDS) preparation and stability Large and small volume parental – physiological and formulation consideration, Manufacturing and evaluation. 10 Hrs

   b. Optimization techniques in Pharmaceutical Formulation: Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation 10 Hrs

2 Validation : Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipments, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities. 10 Hrs

3 cGMP & Industrial Management: Objectives and policies of current good manufacturing practices, layout of buildings, services, equipments and their maintenance Production management: Production organization, , materials management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship. Concept of Total Quality Management. 10 Hrs

4	Compression and compaction: Physics of tablet compression, compression, consolidation, effect of friction, distribution of forces, compaction profiles. Solubility.	10 Hrs
5	Study of consolidation parameters; Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters, Heckel plots, Similarity factors – f2 and f1, Higuchi and Peppas plot, Linearity Concept of significance, Standard deviation , Chi square test, students T-test , ANOVA test.	10 Hrs

REFERENCES

1. Theory and Practice of Industrial Pharmacy By Lachmann and Libermann
2. Pharmaceutical dosage forms: Tablets Vol. 1-3 by Leon Lachmann.
3. Pharmaceutical Dosage forms: Disperse systems, Vol, 1-2; By Leon Lachmann.
4. Pharmaceutical Dosage forms: Parenteral medications Vol. 1-2; By Leon Lachmann.
5. Modern Pharmaceutics; By Gillbert and S. Banker.
6. Remington's Pharmaceutical Sciences.
7. Advances in Pharmaceutical Sciences Vol. 1-5; By H.S. Bean & A.H. Beckett.
8. Physical Pharmacy; By Alfred martin
9. Bentley's Textbook of Pharmaceutics – by Rawlins.
10. Good manufacturing practices for Pharmaceuticals: A plan for total quality control, Second edition; By Sidney H. Willig.
11. Quality Assurance Guide; By Organization of Pharmaceutical producers of India.
12. Drug formulation manual; By D.P.S. Kohli and D.H.Shah. Eastern publishers, New Delhi.
13. How to practice GMPs; By P.P.Sharma. Vandhana Publications, Agra.
14. Pharmaceutical Process Validation; By Fra. R. Berry and Robert A. Nash.
15. Pharmaceutical Preformulations; By J.J. Wells.
16. Applied production and operations management; By Evans, Anderson, Sweeney and Williams.
17. Encyclopaedia of Pharmaceutical technology, Vol I – III.

REGULATORY AFFAIRS
(MPH 104T)

Scope

Course designed to impart advanced knowledge and skills required to learn the concept of generic drug and their development, various regulatory filings in different countries, different phases of clinical trials and submitting regulatory documents : filing process of IND, NDA and ANDA

- To know the approval process of
- To know the chemistry, manufacturing controls and their regulatory importance
- To learn the documentation requirements for
- To learn the importance and

Objectives:

Upon completion of the course, it is expected that the students will be able to understand

- The Concepts of innovator and generic drugs, drug development process
- The Regulatory guidance's and guidelines for filing and approval process
- Preparation of Dossiers and their submission to regulatory agencies in different countries
- Post approval regulatory requirements for actives and drug products
- Submission of global documents in CTD/ eCTD formats
- Clinical trials requirements for approvals for conducting clinical trials
- Pharmacovigilence and process of monitoring in clinical trials.

THEORY 60 Hrs

1. a. Documentation in Pharmaceutical industry: Master formula record, DMF (Drug Master File), distribution records. Generic drugs product development Introduction , Hatch-Waxman act and amendments, CFR (CODE OF FEDERAL REGULATION) ,drug product performance, in-vitro, ANDA regulatory approval process, NDA approval process, BE and drug product assessment, in -vivo, scale up process approval changes, post marketing surveillance, outsourcing BA and BE to CRO. 12 Hrs

   b. Regulatory requirement for product approval: API, biologics, novel, therapies obtaining NDA, ANDA for generic drugs ways and means of US registration for foreign drugs

2	CMC, post approval regulatory affairs. Regulation for combination products and medical devices.CTD and ECTD format, industry and FDA liaison. ICH – Guidelines of ICH-Q, S E, M. Regulatory requirements of EU, MHRA, TGA and ROW countries.	12 Hrs
3	Non clinical drug development: Global submission of IND, NDA, ANDA. Investigation of medicinal products dossier, dossier (IMPD) and investigator brochure (IB).	12 Hrs
4	Clinical trials: Developing clinical trial protocols. Institutional review board/ independent ethics committee Formulation and working procedures informed Consent process and procedures. HIPAA- new, requirement to clinical study process, pharmacovigilance safety monitoring in clinical trials.	12 Hrs

REFERENCES

1. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and IsaderKaufer,Marcel Dekker series, Vol.143
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P.Martin, Drugs and the Pharmaceutical Sciences,Vol.185, Informa Health care Publishers.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD,5th edition, Drugs and the Pharmaceutical Sciences,Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons.Inc.
5. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics/edited By Douglas J. Pisano, David Mantus.
6. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A.Rozovsky and Rodney K. Adams
7. www.ich.org/
8. www.fda.gov/
9. europa.eu/index_en.htm
10. https://www.tga.gov.au/tga-basics

PHARMACEUTICS PRACTICALS - I
(MPH 105P)

1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on HPLC
4. Experiments based on Gas Chromatography
5. Estimation of riboflavin/quinine sulphate by fluorimetry
6. Estimation of sodium/potassium by flame photometry
7. To perform In-vitro dissolution profile of CR/ SR marketed formulation
8. Formulation and evaluation of sustained release matrix tablets
9. Formulation and evaluation osmotically controlled DDS
10. Preparation and evaluation of Floating DDS- hydro dynamically balanced DDS
11. Formulation and evaluation of Muco adhesive tablets.
12. Formulation and evaluation of trans dermal patches.
13. To carry out preformulation studies of tablets.
14. To study the effect of compressional force on tablets disintegration time.
15. To study Micromeritic properties of powders and granulation.
16. To study the effect of particle size on dissolution of a tablet.
17. To study the effect of binders on dissolution of a tablet.
18. To plot Heckal plot, Higuchi and peppas plot and determine similarity factors.

MOLECULAR PHARMACEUTICS (NANO TECHNOLOGY & TARGETED DDS) (NTDS)

(MPH 201T)

Scope

This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

Objectives

Upon completion of the course student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of NTDS
- The formulation and evaluation of novel drug delivery systems.

THEORY 60 Hrs

1.	Targeted Drug Delivery Systems: Concepts, Events and biological process involved in drug targeting. Tumor targeting and Brain specific delivery.	12 Hrs
2	Targeting Methods: introduction preparation and evaluation. Nano Particles & Liposomes: Types, preparation and evaluation.	12 Hrs
3	Micro Capsules / Micro Spheres: Types, preparation and evaluation , Monoclonal Antibodies ; preparation and application, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes.	12 Hrs
4	Pulmonary Drug Delivery Systems : Aerosols, propellents, ContainersTypes, preparation and evaluation, Intra Nasal Route Delivery systems; Types, preparation and evaluation.	12 Hrs
5	Nucleic acid based therapeutic delivery system : Gene therapy, introduction (ex-vivo & in-vivo gene therapy). Potential target diseases for gene therapy (inherited disorder and cancer). Gene expression systems (viral and nonviral gene transfer). Liposomal gene delivery systems. Biodistribution and Pharmacokinetics. knowledge of therapeutic antisense molecules and aptamers as drugs of future.	12 Hrs

REFERENCES

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded,Marcel Dekker, Inc., New York, 1992.
2. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, VallabhPrakashan, New Delhi, First edition 2002.
3. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, NewDelhi, First edition 1997 (reprint in 2001).

ADVANCED BIOPHARMACEUTICS & PHARMACOKINETICS
(MPH 202T)

Scope

This course is designed to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply biopharmaceutics theories in practical problem solving. Basic theoretical discussions of the principles of biopharmaceutics and pharmacokinetics are provided to help the students' to clarify the concepts.

Objectives

Upon completion of this course it is expected that students will be able understand,

- The basic concepts in biopharmaceutics and pharmacokinetics.
- The use raw data and derive the pharmacokinetic models and parameters the best describe the process of drug absorption, distribution, metabolism and elimination.
- The critical evaluation of biopharmaceutic studies involving drug product equivalency.
- The design and evaluation of dosage regimens of the drugs using pharmacokinetic and biopharmaceutic parameters.
- The potential clinical pharmacokinetic problems and application of basics of pharmacokinetic

THEORY 60 Hrs

1. Drug Absorption from the Gastrointestinal Tract: Gastrointestinal tract, Mechanism of drug absorption, Factors affecting drug absorption, pH–partition theory of drug absorption. Formuulation and physicochemical factors: Dissolution rate, Dissolution process, Noyes–Whitney equation and drug dissolution, Factors affecting the dissolution rate. Gastrointestinal absorption: role of the dosage form: Solution (elixir, syrup and solution) as a dosage form ,Suspension as a dosage form, Capsule as a dosage form, Tablet as a dosage form ,Dissolution methods ,Formulation and processing factors, Correlation of in vivo data with in vitro dissolution data.Transport model: Permeability-Solubility-Charge State and the pH Partition Hypothesis, Properties of the Gastrointestinal Tract (GIT), pH Microclimate Intracellular pH Environment, Tight-Junction Complex. 12 Hrs

2	Biopharmaceutic considerations in drug product design and In Vitro Drug Product Performance: Introduction, biopharmaceutic factors affecting drug bioavailability, rate-limiting steps in drug absorption, physicochemical nature of the drug formulation factors affecting drug product performance, in vitro: dissolution and drug release testing, compendial methods of dissolution, alternative methods of dissolution testing,meeting dissolution requirements,problems of variable control in dissolution testingperformance of drug products. In vitro-in vivo correlation, dissolution profile comparisons, drug product stability,considerations in the design of a drug product.	12 Hrs
3	Pharmacokinetics: Basic considerations, pharmacokinetic models, compartment modeling: one compartment model- IV bolus, IV infusion, extra-vascular. Multi compartment model:two compartment - model in brief, non-linear pharmacokinetics: cause of non-linearity, Michaelis - Menten equation, estimation of k_{max} and v_{max}. Drug interactions: introduction, the effect of protein-binding interactions,the effect of tissue-binding interactions,cytochrome p450-based drug interactions,drug interactions linked to transporters.	12 Hrs
4	Drug Product Performance, In Vivo: Bioavailability and Bioequivalence: drug product performance, purpose of bioavailability studies, relative and absolute availability. methods for assessing bioavailability, bioequivalence studies, design and evaluation of bioequivalence studies, study designs, crossover study designs, evaluation of the data, bioequivalence example, study submission and drug review process. biopharmaceutics classification system, methods. Permeability: In-vitro, in-situ and In-vivo methods.generic biologics (biosimilar drug products),clinical significance of bioequivalence studies, special concerns in bioavailability and bioequivalence studies, generic substitution.	12 Hrs
5	Application of Pharmacokinetics: Modified-Release Drug Products, Targeted Drug Delivery Systems and Biotechnological Products. Introduction to Pharmacokinetics and pharmacodynamic, drug interactions. Pharmacokinetics and pharmacodynamics of biotechnology drugs. Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies.	12 Hrs

REFERENCES

1. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi, 4th edition,Philadelphia, Lea and Febiger, 1991
2. Biopharmaceutics and Pharmacokinetics, A. Treatise, D .M. Brahmankar and Sunil B. Jaiswal., VallabPrakashan, Pitampura, Delhi
3. Applied Biopharmaceutics and Pharmacokinetics by Shargel. Land YuABC, 2nd edition, Connecticut Appleton Century Crofts, 1985
4. Textbook of Biopharmaceutics and Pharmacokinetics, Dr. Shobha Rani R. Hiremath,Prism Book
5. Pharmacokinetics by Milo Gibaldi and D. Perrier, 2nd edition, Marcel Dekker Inc.,New York, 1982
6. Current Concepts in Pharmaceutical Sciences: Biopharmaceutics, Swarbrick. J, Leaand Febiger, Philadelphia, 1970
7. Clinical Pharmacokinetics, Concepts and Applications 3rd edition by MalcolmRowland and Thom~ N. Tozer, Lea and Febiger, Philadelphia, 1995
8. Dissolution, Bioavailability and Bioequivalence, Abdou. H.M, Mack PublishingCompany, Pennsylvania 1989
9. Biopharmaceutics and Clinical Pharmacokinetics, An Introduction, 4th edition,revised and expande by Robert. E. Notari, Marcel Dekker Inc, New York and Basel,1987.
10. Biopharmaceutics and Relevant Pharmacokinetics by John. G Wagner and M.Pemarowski, 1st edition, Drug Intelligence Publications, Hamilton, Illinois, 1971.
11. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996.
12. Basic Pharmacokinetics,1 st edition,Sunil S JambhekarandPhilip J Breen,pharmaceutical press, RPS Publishing,2009.
13. Absorption and Drug Development- Solubility, Permeability, and Charge State, Alex Avdeef, John Wiley & Sons, Inc,2003.

COMPUTER AIDED DRUG DEVELOPMENT
(MPH 203T)

Scope

This course is designed to impart knowledge and skills necessary for computer Applications in pharmaceutical research and development who want to understand the application of computers across the entire drug research and development process. Basic theoretical discussions of the principles of more integrated and coherent use of computerized information (informatics) in the drug development process are provided to help the students to clarify the concepts.

Objectives

Upon completion of this course it is expected that students will be able to understand,

- History of Computers in Pharmaceutical Research and Development
- Computational Modeling of Drug Disposition
- Computers in Preclinical Development
- Optimization Techniques in Pharmaceutical Formulation
- Computers in Market Analysis
- Computers in Clinical Development
- Artificial Intelligence (AI) and Robotics
- Computational fluid dynamics(CFD)

THEORY		60 Hrs
1.	a. Computers in Pharmaceutical Research and Development: A General Overview: History of Computers in Pharmaceutical Research and Development. Statistical modeling in Pharmaceutical research and development: Descriptive versus Mechanistic Modeling, Statistical Parameters, Estimation, Confidence Regions, Nonlinearity at the Optimum, Sensitivity Analysis, Optimal Design, Population Modeling b. Quality-by-Design In Pharmaceutical Development: Introduction, ICH Q8 guideline, Regulatory and industry views on QbD, Scientifically based QbD – examples of application.	12 Hrs
2	Computational Modeling Of Drug Disposition: Introduction ,Modeling Techniques: Drug Absorption, Solubility, Intestinal Permeation, Drug Distribution ,Drug Excretion, Active Transport; P-gp, BCRP, Nucleoside Transporters, hPEPT1, ASBT, OCT, OATP, BBB–Choline Transporter.	12 Hrs

3	Computer-aided formulation development:: Concept of optimization, Optimization parameters, Factorial design, Optimization technology & Screening design. Computers in Pharmaceutical Formulation: Development of pharmaceutical emulsions, microemulsion drug carriers Legal Protection of Innovative Uses of Computers in R&D, The Ethics of Computing in Pharmaceutical Research, Computers in Market analysis	12 Hrs
4	a. Computer-aided biopharmaceutical characterization: Gastrointestinal absorption simulation. Introduction, Theoretical background, Model construction, Parameter sensitivity analysis, Virtual trial, Fed vs. fasted state, In vitro dissolution and in vitro-in vivo correlation, Biowaiver considerations b. Computer Simulations in Pharmacokinetics and Pharmacodynamics: Introduction, Computer Simulation: Whole Organism, Isolated Tissues, Organs, Cell, Proteins and Genes. c. Computers in Clinical Development: Clinical Data Collection and Management, Regulation of Computer Systems	12 Hrs
5	Artificial Intelligence (AI), Robotics and Computational fluid dynamics: General overview, Pharmaceutical Automation, Pharmaceutical applications, Advantages and Disadvantages. Current Challenges and Future Directions.	12 Hrs

REFERENCES

1. Computer Applications in Pharmaceutical Research and Development, Sean Ekins, 2006, John Wiley & Sons.
2. Computer-Aided Applications in Pharmaceutical Technology, 1st Edition, Jelena Djuris, Woodhead Publishing
3. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996.

COSMETICS AND COSMECEUTICALS
(MPH 204T)

Scope

This course is designed to impart knowledge and skills necessary forthefundamental need for cosmetic and cosmeceutical products.

Objectives

Upon completion of the course, the students shall be able to understand

- Key ingredients used in cosmetics and cosmeceuticals.
- Key building blocks for various formulations.
- Current technologies in the market
- Various key ingredients and basic science to develop cosmetics and cosmeceuticals
- Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

THEORY 60 Hrs

1. Cosmetics – Regulatory : Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labeling of cosmetics Regulatory provisions relating to import of cosmetics., Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics – Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties. 12 Hrs

2 Cosmetics - Biological aspects : Structure of skin relating to problems like dry skin, acne, pigmentation, prickly heat, wrinkles and body odor. Structure of hair and hair growth cycle. Common problems associated with oral cavity. Cleansing and care needs for face, eye lids, lips, hands, feet, nail, scalp, neck, body and under-arm. 12 Hrs

3 Formulation Building blocks: Building blocks for different product formulations of cosmetics/cosmeceuticals. Surfactants – Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste. Soaps and syndetbars. 12 Hrs

Perfumes; Classification of perfumes. Perfume ingredients listed as allergens in EU regulation.

	Controversial ingredients: Parabens, formaldehyde liberators, dioxane.	
4	Design of cosmeceutical products: Sun protection, sunscreens classification and regulatory aspects. Addressing dry skin, acne, sun-protection, pigmentation, prickly heat, wrinkles, body odor., dandruff, dental cavities, bleeding gums, mouth odor and sensitive teeth through cosmeceutical formulations.	12 Hrs
5	Herbal Cosmetics : Herbal ingredients used in Hair care, skin care and oral care. Review of guidelines for herbal cosmetics by private bodies like cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics.	12 Hrs

REFERENCES

1. Harry's Cosmeticology. 8th edition.
2. Poucher'sperfumecosmeticsandSoaps,10th edition.
3. Cosmetics – Formulation, Manufacture and quality control, PP.Sharma,4th edition
4. Handbook of cosmetic science and Technology A.O.Barel, M.Paye and H.I. Maibach. 3 rd edition
5. Cosmetic and Toiletries recent suppliers catalogue.
6. CTFA directory.

PHARMACEUTICS PRACTICALS - II
(MPH 205P)

1. To study the effect of temperature change , non solvent addition, incompatible polymer addition in microcapsules preparation
2. Preparation and evaluation of Alginate beads
3. Formulation and evaluation of gelatin /albumin microspheres
4. Formulation and evaluation of liposomes/niosomes
5. Formulation and evaluation of spherules
6. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique.
7. Comparison of dissolution of two different marketed products /brands
8. Protein binding studies of a highly protein bound drug & poorly protein bound drug
9. Bioavailability studies of Paracetamol in animals.
10. Pharmacokinetic and IVIVC data analysis by Winnoline^{R} software
11. In vitro cell studies for permeability and metabolism
12. DoE Using Design Expert® Software
13. Formulation data analysis Using Design Expert® Software
14. Quality-by-Design in Pharmaceutical Development
15. Computer Simulations in Pharmacokinetics and Pharmacodynamics
16. Computational Modeling Of Drug Disposition
17. To develop Clinical Data Collection manual
18. To carry out Sensitivity Analysis, and Population Modeling.
19. Development and evaluation of Creams
20. Development and evaluation of Shampoo and Toothpaste base
21. To incorporate herbal and chemical actives to develop products
22. To address Dry skin, acne, blemish, Wrinkles, bleeding gums and dandruff

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM 302T	Journal club	1	1
MRM 303T	Discussion / Presentation (Proposal Presentation)	2	2
-	Research Work	28	14
Total		35	21

MRM 301T- Research Methodology & Biostatistics

UNIT – I

General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree offreedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual

relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

M. PHARM.
COURSE CURRICULUM
(W.E.F 2020-21)

INSTITUTE OF
PHARMACEUTICAL RESEARCH

Table 2: M. Pharm (Pharmacology)

Course Code	Course	Credit Hours	Credit Points	Hrs./wk	Marks
Semester I					
MPL 101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPL 102T	Advanced Pharmacology-I	4	4	4	100
MPL 103T	Pharmacological and Toxicological Screening Methods-I	4	4	4	100
MPL 104T	Cellular and Molecular Pharmacology	4	4	4	100
MPL 105P	Pharmacology Practical I	12	6	12	150
-	Seminar/Assignment	7	4	7	100
Total		35	26	35	650
Semester II					
MPL 201T	Advanced Pharmacology II	4	4	4	100
MPL 202T	Pharmacological and Toxicological Screening Methods-II	4	4	4	100
MPL 203T	Principles of Drug Discovery	4	4	4	100
MPL 204T	Experimental Pharmacology practical- II	4	4	4	100
MPL 205P	Pharmacology Practical II	12	6	12	150
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Table 3: M. Pharm (Pharmaceutics and Pharmacology)
Common to Both Branches

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM 302T	Journal club	1	1
MRM 303T	Discussion / Presentation (Proposal Presentation)	2	2
-	Research Work	28	14
Total		35	21

* Non University Exam

PHARMACOLOGY (MPL)

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPL 101T)

Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know about,

- Chemicals and Excipients
- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

THEORY 60 Hrs

1. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy. 10 Hrs

   IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation.

   Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence (Characterestics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

   Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

2 NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. 10 Hrs

3	Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.	10 Hrs
4	Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: j) Thin Layer chromatography k) High Performance Thin Layer Chromatography l) Ion exchange chromatography m) Column chromatography n) Gas chromatography o) High Performance Liquid chromatography p) Ultra High Performance Liquid chromatography q) Affinity chromatography r) Gel Chromatography	10 Hrs
5	Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing X ray Crystallography: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.	10 Hrs
6	Potentiometry: Principle, working, Ion selective Electrodes and Application of potentiometry. Thermal Techniques: Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.	10 Hrs

REFERENCES

1. Spectrometric Identification of Organic compounds – Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis – Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy – William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation – P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis – Modern Methods – Part B – J W Munson, Vol 11, Marcel. Dekker Series
8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.
9. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley& Sons, 1982.

ADVANCED PHARMACOLOGY - I
(MPL 102T)

Scope

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, this subject helps the students to understand the concepts of drug action and mechanisms involved

Objectives

Upon completion of the course the student shall be able to :

- Discuss the pathophysiology and pharmacotherapy of certain diseases
- Explain the mechanism of drug actions at cellular and molecular level
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

THEORY — 60 Hrs

1. General Pharmacology — 12 Hrs

a. Pharmacokinetics: The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding.

b. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors, quantitation of drug receptors interaction and elicited effects.

2 Neurotransmission — 12 Hrs

a. General aspects and steps involved in neurotransmission.

b. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetyl choline).

c. Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine].

d. Non adrenergic non cholinergic transmission (NANC). Co-transmission

Systemic Pharmacology

A detailed study on pathophysiology of diseases, mechanism of action, pharmacology and toxicology of existing as well as novel drugs used in the following systems

Autonomic Pharmacology

Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting
neuromuscular junction

3	Central nervous system Pharmacology General and local anesthetics Sedatives and hypnotics, drugs used to treat anxiety. Depression, psychosis, mania, epilepsy, neurodegenerative diseases. Narcotic and non-narcotic analgesics.	12 Hrs
4	Cardiovascular Pharmacology Diuretics, antihypertensives, antiischemics, anti- arrhythmics, drugs for heart failure and hyperlipidemia. Hematinics, coagulants , anticoagulants, fibrinolytics and anti-platelet drugs	12 Hrs
5	Autocoid Pharmacology The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids. Pharmacology of antihistamines, 5HT antagonists.	12 Hrs

REFEERENCES

1. The Pharmacological Basis of Therapeutics, Goodman and Gillman's
2. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.
3. Basic and Clinical Pharmacology by B.G Katzung
4. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
6. Graham Smith. Oxford textbook of Clinical Pharmacology.
7. Avery Drug Treatment
8. Dipiro Pharmacology, Pathophysiological approach.
9. Green Pathophysiology for Pharmacists.

10. Robbins & Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology)
11. A Complete Textbook of Medical Pharmacology by Dr. S.K Srivastava published by APC Avichal Publishing Company
12. KD.Tripathi. Essentials of Medical Pharmacology.
13. Modern Pharmacology with Clinical Applications, Craig Charles R. & Stitzel Robert E., Lippincott Publishers.
14. Clinical Pharmacokinetics & Pharmacodynamics : Concepts and Applications – Malcolm Rowland and Thomas N.Tozer, Wolters Kluwer, Lippincott Williams & Wilkins Publishers.
15. Applied biopharmaceutics and Pharmacokinetics, Pharmacodynamics and Drug metabolism for industrial scientists.
16. Modern Pharmacology, Craig CR. & Stitzel RE, Little Brown & Company.

PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS - I
(MPL 103T)

Scope

This subject is designed to impart the knowledge on preclinical evaluation of drugs and recent experimental techniques in the drug discovery and development. The subject content helps the student to understand the maintenance of laboratory animals as per the guidelines, basic knowledge of various in-vitro and in-vivo preclinical evaluation processes

Objectives

Upon completion of the course the student shall be able to,

- Appraise the regulations and ethical requirement for the usage of experimental animals.
- Describe the various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experimental animals
- Describe the various newer screening methods involved in the drug discovery process
- Appreciate and correlate the preclinical data to humans

THEORY 60 Hrs

1. Laboratory Animals — 12 Hrs

Common laboratory animals: Description, handling and applications of different species and strains of animals.

Transgenic animals: Production, maintenance and applications
Anaesthesia and euthanasia of experimental animals.
Maintenance and breeding of laboratory animals.
CPCSEA guidelines to conduct experiments on animals

Good laboratory practice.
Bioassay-Principle, scope and limitations and methods

2 Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. — 12 Hrs

General principles of preclinical screening. CNS Pharmacology: behavioral and muscle co ordination, CNS stimulants and

depressants, anxiolytics, anti-psychotics, anti epileptics and nootropics. Drugs for neurodegenerative diseases like Parkinsonism, Alzheimers and multiple sclerosis. Drugs acting on Autonomic Nervous System.

3	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Respiratory Pharmacology: anti-asthmatics, drugs for COPD and anti allergics. Reproductive Pharmacology: Aphrodisiacs and antifertility agents Analgesics, antiinflammatory and antipyretic agents. Gastrointestinal drugs: anti ulcer, anti -emetic, anti-diarrheal and laxatives.	12 Hrs
4	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Cardiovascular Pharmacology: antihypertensives, antiarrythmics, antianginal, antiatherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic, antidyslipidemic agents. Anti cancer agents. Hepatoprotective screening methods.	12 Hrs
5	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Iimmunomodulators, Immunosuppressants and immunostimulants General principles of immunoassay: theoretical basis and optimization of immunoassay, heterogeneous and homogenous immunoassay systems. Immunoassay methods evaluation; protocol outline, objectives and preparation. Immunoassay for digoxin and insulin Limitations of animal experimentation and alternate animal experiments. Extrapolation of in vitro data to preclinical and preclinical to humans	12 Hrs

REFERENCES

1. Biological standardization by J.H. Burn D.J. Finney and I.G. Goodwin
2. Screening methods in Pharmacology by Robert Turner. A
3. Evaluation of drugs activities by Laurence and Bachrach
4. Methods in Pharmacology by Arnold Schwartz.
5. Fundamentals of experimental Pharmacology by M.N.Ghosh
6. Pharmacological experiment on intact preparations by Churchill Livingstone
7. Drug discovery and Evaluation by Vogel H.G.
8. Experimental Pharmacology by R.K.Goyal.
9. Preclinical evaluation of new drugs by S.K. Guta
10. Handbook of Experimental Pharmacology, SK.Kulkarni
11. Practical Pharmacology and Clinical Pharmacy, SK.Kulkarni, 3rd Edition.
12. David R.Gross. Animal Models in Cardiovascular Research, 2nd Edition, Kluwer Academic Publishers, London, UK.
13. Screening Methods in Pharmacology, Robert A.Turner.
14. Rodents for Pharmacological Experiments, Dr.Tapan Kumar chatterjee.
15. Practical Manual of Experimental and Clinical Pharmacology by Bikash Medhi (Author), Ajay Prakash (Author)

CELLULAR AND MOLECULAR PHARMACOLOGY
(MPL 104T)

Scope:

The subject imparts a fundamental knowledge on the structure and functions of cellular components and help to understand the interaction of these components with drugs. This information will further help the student to apply the knowledge in drug discovery process.

Objectives:

Upon completion of the course, the student shall be able to,

- Explain the receptor signal transduction processes.
- Explain the molecular pathways affected by drugs.
- Appreciate the applicability of molecular pharmacology and biomarkers in drug discovery process.
- Demonstrate molecular biology techniques as applicable for pharmacology

THEORY 60 Hrs

1. **Cell biology** 12 Hrs

Structure and functions of cell and its organelles

Genome organization. Gene expression and its regulation, importance of siRNA and micro RNA, gene mapping and gene sequencing

Cell cycles and its regulation.

Cell death- events, regulators, intrinsic and extrinsic pathways of apoptosis.

Necrosis and autophagy.

2 **Cell signaling** 12 Hrs

Intercellular and intracellular signaling pathways.

Classification of receptor family and molecular structure ligand gated ion channels; G-protein coupled receptors, tyrosine kinase receptors and nuclear receptors.

Secondary messengers: cyclic AMP, cyclic GMP, calcium ion, inositol 1,4,5-trisphosphate, (IP3), NO, and diacylglycerol.

Detailed study of following intracellular signaling pathways: cyclic AMP signaling pathway, mitogen-activated protein kinase (MAPK) signaling, Janus kinase (JAK)/signal transducer and activator of transcription (STAT) signaling pathway.

3	Principles and applications of genomic and proteomic tools DNA electrophoresis, PCR (reverse transcription and real time), Gene sequencing, micro array technique, SDS page, ELISA and western blotting. Recombinant DNA technology and gene therapy Basic principles of recombinant DNA technology–Restriction enzymes, various types of vectors. Applications of recombinant DNA technology. Gene therapy– Various types of gene transfer techniques, clinical applications and recent advances in gene therapy.	12 Hrs
4	Pharmacogenomics Gene mapping and cloning of disease gene. Genetic variation and its role in health/ pharmacology Polymorphisms affecting drug metabolism Genetic variation in drug transporters Genetic variation in G protein coupled receptors Applications of proteomics science: Genomics, proteomics, metabolomics, functionomics, nutrigenomics Immunotherapeutics Types of immunotherapeutics, humanisation antibody therapy, Immunotherapeutics in clinical practice	12 Hrs
5	a. Cell culture techniques Basic equipments used in cell culture lab. Cell culture media, various types of cell culture, general procedure for cell cultures; isolation of cells, subculture, cryopreservation, characterization of cells and their application. Principles and applications of cell viability assays, glucose uptake assay, Calcium influx assays Principles and applications of flow cytometry b. Biosimilars	12 Hrs

REFERENCES:

1. The Cell, A Molecular Approach. Geoffrey M Cooper.
2. Pharmacogenomics: The Search for Individualized Therapies. Edited by J. Licinio and M –L. Wong
3. Handbook of Cell Signaling (Second Edition) Edited by Ralph A. et.al
4. Molecular Pharmacology: From DNA to Drug Discovery. John Dickenson et.al
5. Basic Cell Culture protocols by Cheril D.Helgason and Cindy L.Miller
6. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor)
7. Animal Cell Culture: A Practical Approach by John R. Masters (Editor)
8. Current porotocols in molecular biology vol I to VI edited by Frederick M.Ausuvel et la.

PHARMACOLOGICAL PRACTICAL - I
(MPL 105P)

1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on HPLC
4. Experiments based on Gas Chromatography
5. Estimation of riboflavin/quinine sulphate by fluorimetry
6. Estimation of sodium/potassium by flame photometry

Handling of laboratory animals.

1. Various routes of drug administration.
2. Techniques of blood sampling, anesthesia and euthanasia of experimental animals.
3. Functional observation battery tests (modified Irwin test)
4. Evaluation of CNS stimulant, depressant, anxiogenics and anxiolytic, anticonvulsant activity.
5. Evaluation of analgesic, anti-inflammatory, local anesthetic, mydriatic and miotic activity.
6. Evaluation of diuretic activity.
7. Evaluation of antiulcer activity by pylorus ligation method.
8. Oral glucose tolerance test.
9. Isolation and identification of DNA from various sources (Bacteria, Cauliflower, onion, Goat liver).
10. Isolation of RNA from yeast
11. Estimation of proteins by Braford/Lowry's in biological samples.
12. Estimation of RNA/DNA by UV Spectroscopy
13. Gene amplification by PCR.
14. Protein quantification Western Blotting.
15. Enzyme based in-vitro assays (MPO, AChEs, α amylase, α glucosidase).
16. Cell viability assays (MTT/Trypan blue/SRB).
17. DNA fragmentation assay by agarose gel electrophoresis.
18. DNA damage study by Comet assay.
19. Apoptosis determination by fluorescent imaging studies.
20. Pharmacokinetic studies and data analysis of drugs given by different routes of administration using softwares
21. Enzyme inhibition and induction activity
22. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (UV)
23. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (HPLC)

REFERENCES

1. CPCSEA, OECD, ICH, USFDA, Schedule Y, EPA guidelines,
2. Fundamentals of experimental Pharmacology by M.N.Ghosh
3. Handbook of Experimental Pharmacology by S.K. Kulkarni.
4. Drug discovery and Evaluation by Vogel H.G.
5. Spectrometric Identification of Organic compounds – Robert M Silverstein,
6. Principles of Instrumental Analysis – Doglas A Skoog, F. James Holler, Timothy A. Nieman,
7. Vogel's Text book of quantitative chemical analysis - Jeffery, Basset, Mendham, Denney,
8. Basic Cell Culture protocols by Cheril D. Helgason and Cindy L.Mille
9. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor)
10. Animal Cell Culture: A Practical Approach by John R. Masters (Editor)
11. Practical Manual of Experimental and Clinical Pharmacology by Bikash Medhi(Author), Ajay Prakash (Author) Jaypee brothers' medical publishers Pvt. Ltd

ADVANCED PHARMACOLOGY - II
(MPL 201T)

Scope

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, the subject helps the student to understand the concepts of drug action and mechanism involved

Objectives

Upon completion of the course the student shall be able to:

- Explain the mechanism of drug actions at cellular and molecular level
- Discuss the Pathophysiology and pharmacotherapy of certain diseases
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

THEORY 60 Hrs

1. Endocrine Pharmacology 12 Hrs

Molecular and cellular mechanism of action of hormones such as growth hormone, prolactin, thyroid, insulin and sex hormones

Anti-thyroid drugs, Oral hypoglycemic agents, Oral contraceptives, Corticosteroids.

Drugs affecting calcium regulation

2 Chemotherapy 12 Hrs

Cellular and molecular mechanism of actions and resistance of antimicrobial agents such as ß-lactams, aminoglycosides, quinolones, Macrolide antibiotics. Antifungal, antiviral, and anti-TB drugs.

3 Chemotherapy 12 Hrs

Drugs used in Protozoal Infections

Drugs used in the treatment of Helminthiasis

Chemotherapy of cancer

Immunopharmacology

Cellular and biochemical mediators of inflammation and immune response. Allergic or hypersensitivity reactions. Pharmacotherapy of asthma and COPD.

Immunosuppressants and Immunostimulants

4	GIT Pharmacology Antiulcer drugs, Prokinetics, antiemetics, anti-diarrheals and drugs for constipation and irritable bowel syndrome. Chronopharmacology Biological and circadian rhythms, applications of chronotherapy in various diseases like cardiovascular disease, diabetes, asthma and peptic ulcer	12 Hrs
5	Free radicals Pharmacology Generation of free radicals, role of free radicals in etiopathology of various diseases such as diabetes, neurodegenerative diseases and cancer. Protective activity of certain important antioxidant Recent Advances in Treatment: Alzheimer's disease, Parkinson's disease, Cancer, Diabetes mellitus	12 Hrs

REFERENCES

1. The Pharmacological basis of therapeutics- Goodman and Gill man's
2. Principles of Pharmacology. The Pathophysiologic basis of drug therapy by David E Golan et al.
3. Basic and Clinical Pharmacology by B.G -Katzung
4. Pharmacology by H.P. Rang and M.M. Dale.
5. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.
6. Text book of Therapeutics, drug and disease management by E T. Herfindal and Gourley.
7. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
8. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Industrial Scientists
9. Robbins & Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology)
10. A Complete Textbook of Medical Pharmacology by Dr. S.K Srivastava published by APC Avichal Publishing Company.
11. KD.Tripathi. Essentials of Medical Pharmacology
12. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers

PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS-II
(MPL 202T)

Scope:

This subject imparts knowledge on the preclinical safety and toxicological evaluation of drug & new chemical entity. This knowledge will make the student competent in regulatory toxicological evaluation.

Objectives:

Upon completion of the course, the student shall be able to,

- Explain the various types of toxicity studies.
- Appreciate the importance of ethical and regulatory requirements for toxicity studies.
- Demonstrate the practical skills required to conduct the preclinical toxicity studies.

THEORY	60 Hrs
1. Basic definition and types of toxicology (general, mechanistic, regulatory and descriptive) Regulatory guidelines for conducting toxicity studies OECD, ICH, EPA and Schedule Y OECD principles of Good laboratory practice (GLP) History, concept and its importance in drug development	12 Hrs
2 Acute, sub-acute and chronic- oral, dermal and inhalational studies as per OECD guidelines. Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies. Test item characterization- importance and methods in regulatory toxicology studies	12 Hrs
3 Reproductive toxicology studies, Male reproductive toxicity studies, female reproductive studies (segment I and segment III), teratogenecity studies (segment II) Genotoxicity studies (Ames Test, in vitro and in vivo Micronucleus and Chromosomal aberrations studies) In vivo carcinogenicity studies	12 Hrs
4 IND enabling studies (IND studies)- Definition of IND, importance of IND, industry perspective, list of studies needed for IND submission.	12 Hrs

Safety pharmacology studies- origin, concepts and importance of safety pharmacology.
Tier1- CVS, CNS and respiratory safety pharmacology, HERG assay. Tier2- GI, renal and other studies

5 Toxicokinetics- Toxicokinetic evaluation in preclinical studies, saturation kinetics Importance and applications of toxicokinetic studies. 12 Hrs
Alternative methods to animal toxicity testing.

REFERENCES

1. Hand book on GLP, Quality practices for regulated non-clinical research and development (http://www.who.int/tdr/publications/documents/glp-handbook.pdf).
2. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 2005, ministry of health and family welfare (department of health) New Delhi
3. Drugs from discovery to approval by Rick NG.
4. Animal Models in Toxicology, 3rd Edition, Lower and Bryan
5. OECD test guidelines.
6. Principles of toxicology by Karen E. Stine, Thomas M. Brown.
7. Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals (http://www.fda.gov/downloads/drugs/guidancecomplianceregulatoryinformation/guidances/ucm073246.pdf)

PRINCIPLES OF DRUG DISCOVERY
(MPL 203T)

Scope:

The subject imparts basic knowledge of drug discovery process. This information will make the student competent in drug discovery process

Objectives:

Upon completion of the course, the student shall be able to,

- Explain the various stages of drug discovery.
- Appreciate the importance of the role of genomics, proteomics and bioinformatics in drug discovery
- Explain various targets for drug discovery.
- Explain various lead seeking method and lead optimization
- Appreciate the importance of the role of computer aided drug design in drug discovery

THEORY 60 Hrs

1. An overview of modern drug discovery process: Target identification, target validation, lead identification and lead Optimization. Economics of drug discovery. 12 Hrs
   Target Discovery and validation-Role of Genomics, Proteomics and Bioinformatics. Role of Nucleic acid microarrays, Protein microarrays, Antisense technologies, siRNAs, antisense oligonucleotides, Zinc finger proteins. Role of transgenic animals in target validation.
2. Lead Identification- combinatorial chemistry & high throughput screening, in silico lead discovery techniques, Assay development for hit identification. 12 Hrs
   Protein structure
   Levels of protein structure, Domains, motifs, and folds in protein structure. Computational prediction of protein structure: Threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction
3. Rational Drug Design 12 Hrs
   Traditional vs rational drug design, Methods followed in traditional drug design, High throughput screening, Concepts of Rational Drug Design, Rational Drug Design Methods: Structure and Pharmacophore based approaches

	Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening,	
4	Molecular docking: Rigid docking, flexible docking, manual docking; Docking based screening. De novo drug design. Quantitative analysis of Structure Activity Relationship History and development of QSAR, SAR versus QSAR, Physicochemical parameters, Hansch analysis, Fee Wilson analysis and relationship between them.	12 Hrs
5	QSAR Statistical methods – regression analysis, partial least square analysis (PLS) and other multivariate statistical methods. 3D-QSAR approaches like COMFA and COMSIA Prodrug design-Basic concept, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design	12 Hrs

REFERENCES

1. MouldySioud. Target Discovery and Validation Reviews and Protocols: Volume 2 Emerging Molecular Targetsand Treatment Options. 2007 Humana Press Inc.
2. Darryl León. Scott MarkelIn. Silico Technologies in Drug Target Identification and Validation. 2006 by Taylor and Francis Group, LLC.
3. Johanna K. DiStefano. Disease Gene Identification. Methods and Protocols. Springer New York Dordrecht Heidelberg London.
4. Hugo Kubiny. QSAR: Hansch Analysis and Related Approaches. Methods and Principles in Medicinal Chemistry. Publisher Wiley-VCH
5. Klaus Gubernator, Hans-Joachim Böhm. Structure-Based Ligand Design. Methods and Principles in Medicinal Chemistry. Publisher Wiley-VCH
6. Abby L . Parrill. M . Rami Reddy. Rational Drug Design. Novel Methodology and Practical Applications. ACS Symposium Series; American Chemical Society: Washington, DC, 1999.
7. J. Rick Turner. New drug development design, methodology and, analysis. John Wiley & Sons, Inc., New Jersey.

CLINICAL RESEARCH AND PHARMACOVIGILANCE
(MPL 204T)

Scope:

This subject will provide a value addition and current requirement for the students in clinical research and pharmacovigilance. It will teach the students on conceptualizing, designing, conducting, managing and reporting of clinical trials. This subject also focuses on global scenario of Pharmacovigilance in different methods that can be used to generate safety data. It will teach the students in developing drug safety data in Pre-clinical, Clinical phases of Drug development and post market surveillance.

Objectives:

Upon completion of the course, the student shall be able to,

- Explain the regulatory requirements for conducting clinical trial
- Demonstrate the types of clinical trial designs
- Explain the responsibilities of key players involved in clinical trials
- Execute safety monitoring, reporting and close-out activities
- Explain the principles of Pharmacovigilance
- Detect new adverse drug reactions and their assessment
- Perform the adverse drug reaction reporting systems and communication in Pharmacovigilance

THEORY 60 Hrs

1. Regulatory Perspectives of Clinical Trials: 12 Hrs

   Origin and Principles of International Conference on Harmonization - Good Clinical Practice (ICH-GCP) guidelines

   Ethical Committee: Institutional Review Board, Ethical Guidelines for Biomedical Research and Human Participant- Schedule Y, ICMR

   Informed Consent Process: Structure and content of an Informed Consent Process Ethical principles governing informed consent process

2 Clinical Trials: Types and Design 12 Hrs

   Experimental Study- RCT and Non RCT,
   Observation Study: Cohort, Case Control, Cross sectional
   Clinical Trial Study Team

   Roles and responsibilities of Clinical Trial Personnel: Investigator, Study Coordinator, Sponsor, Contract Research Organization and its management

3	Clinical Trial Documentation- Guidelines to the preparation of documents, Preparation of protocol, Investigator Brochure, Case Report Forms, Clinical Study Report Clinical Trial Monitoring- Safety Monitoring in CT Adverse Drug Reactions: Definition and types. Detection and reporting methods. Severity and seriousness assessment.Predictability and preventability assessment, Management of adverse drug reactions; Terminologies of ADR.	12 Hrs
4	Basic aspects, terminologies and establishment of pharmacovigilance History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring programme, WHO and Regulatory terminologies of ADR, evaluation of medication safety, Establishing pharmacovigilance centres in Hospitals, Industry and National programmes related to pharmacovigilance. Roles and responsibilities in Pharmacovigilance	12 Hrs
5	Methods, ADR reporting and tools used in Pharmacovigilance International classification of diseases, International Non-proprietary names for drugs, Passive and Active surveillance, Comparative observational studies, Targeted clinical investigations and Vaccine safety surveillance. Spontaneous reporting system and Reporting to regulatory authorities, Guidelines for ADRs reporting. Argus, Aris G Pharmacovigilance, VigiFlow, Statistical methods for evaluating medication safety data.	12 Hrs
6	Pharmacoepidemiology, pharmacoeconomics, safety pharmacology	12 Hrs

REFERENCES

1. Central Drugs Standard Control Organization- Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health;2001.
2. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996.

3. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.
4. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons.
5. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition, Jan 2000, Wiley Publications.
6. Handbook of clinical Research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone.
7. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.

PHARMACOLOGICAL PRACTICAL - II(MPL 205P)

1. To record the DRC of agonist using suitable isolated tissues preparation.
2. To study the effects of antagonist/potentiating agents on DRC of agonistusing suitable isolated tissue preparation.
3. To determine to the strength of unknown sample by matching bioassay by using suitable tissue preparation.
4. To determine to the strength of unknown sample by interpolation bioassayby using suitable tissue preparation
5. To determine to the strength of unknown sample by bracketing bioassayby using suitable tissue preparation
6. To determine to the strength of unknown sample by multiple pointbioassay by using suitable tissue preparation.
7. Estimation of PA_2 values of various antagonists using suitable isolatedtissue preparations.
8. To study the effects of various drugs on isolated heart preparations
9. Recording of rat BP, heart rate and ECG.
10. Recording of rat ECG
11. Drug absorption studies by averted rat ileum preparation.
12. Acute oral toxicity studies as per OECD guidelines.
13. Acute dermal toxicity studies as per OECD guidelines.
14. Repeated dose toxicity studies- Serum biochemical, haematological, urineanalysis, functional observation tests and histological studies.
15. Drug mutagenicity study using mice bone-marrow chromosomal aberrationtest.
16. Protocol design for clinical trial.(3 Nos.)
17. Design of ADR monitoring protocol.
18. In-silico docking studies. (2 Nos.)
19. In-silico pharmacophore based screening.
20. In-silico QSAR studies.
21. ADR reporting

REFERENCES

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh
2. Hand book of Experimental Pharmacology-S.K.Kulakarni
3. Text book of in-vitro practical Pharmacology by Ian Kitchen
4. Bioassay Techniques for Drug Development by Atta-ur-Rahman, Iqbalchoudhary and William Thomsen
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel andAndrew B.C.Yu.
6. Handbook of Essential Pharmacokinetics, Pharmacodynamics and DrugMetabolism for Industrial Scientists.

M. Pharm (Pharmaceutics & Pharmacology)Common for Both Branches

Semester III

MRM 301T- Research Methodology & Biostatistics

UNIT - I

General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

UNIT - II

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

UNIT - III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT - IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT - V

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

GLA UNIVERSITY
MATHURA
Established vide U.P. Act 21 of 2010.

COURSE STRUCTURE & SYLLABUS

Ph.D. Programme

Department of Pharmaceutical Sciences

COURSE STRUCTURE & SYLLABUS

CREDIT COURSES

COMPULSORY SUBJECTS

PMG-1001 Research Methodology
PRPH0001 Research Methodology
PREC-OO10 Research & Publication Ethics
PBS1002 Bioinformatics and Instrumentation.

DISCIPLINE / SPECIALIZATION SUBJECTS

Pharmaceutical Sciences

PPS 1001: Advances in Organic Chemistry
PPS1002: Current Approaches in Advanced Pharmacology
PPS 1003: Advances in Pharmaceutical Sciences
PPS 1004: Pharmacognosy & Phytochemistry

COURSE STRUCRURE

COMPULSARY SUBJECTS							
S. No.	SUBJECT CODE	SUBJECT	PERIODS			CREDITS	CONTACT HRS/WK
			L	T	P		
1	PMG-1001	Research Methodology	45	0	0	4	4
2	PRPH0001	Research Methodology	45	0	0	4	4
3	PREC-OO10	Research & Publication Ethics	30	0	0	2	2
4	PBS1002	Bioinformatics and Instrumentation	60	0	0	4	4
DISCIPLINE / SPECIALIZATION SUBJECTS							
5	PPS1001	Advances in Organic Chemistry	60	0	0	4	4
6	PPS1002	Current approaches in advanced pharmacology	60	0	0	4	4
7	PPS1003	Advances in Pharmaceutical Sciences	60	0	0	4	4
8	PPS1004	Pharmacognosy & Phytochemistry	60	0	0	4	4
		TOTAL	**420**		**0**	**30**	**30**

COMPULSORY SUBJECT

PMG-1001 RESEARCH METHODOLOGY

Module No.	Contents	Teaching Hours
I	**Unit-I** Introduction of research, types of research, research process, research design research approaches, criteria of good research. Plagiarism – definition, forms of plagiarism, consequences of plagiarism, unintentional plagiarism, copyright infringement, collaborative work.	15
II	**Unit-II** Data collection, sampling & sampling design-probability sampling, non probability sampling. Statistical tools and techniques: Measures of dispersion, correlation, regression, hypothesis testing parametric tests, construction of control charts. Simulation and numerical methods. Experimental designs and analysis. Development of theory and linkages and interpretation of results. Concepts of Artificial intelligence and associated techniques.	15
III	**Unit-III** Identifying and Defining Research problems, Setting feasible goals & objectives, Improving reading, writing and speaking skills. Principles of research paper, report and thesis writing. Guidelines according to style manuals, report format- writing and presentation of preliminary, main body and references section of report, Bibliography and Annexure in the Report. Development of research proposals and patents.	15

BOOKS/ REFERENCES:

1. Panneer Selvam – Research Methodology, Prentice Hall of India, Edition 2008.
2. Kothari V.R. – Research Methodology Methods & Techniques, New Age International Publishers, 2nd Edition, 2006.
3. Gupta and Singh – Research Methodology, Vayu Education of India, New Delhi.
4. Bhattacharya, D.K. (2004) – Research Methodology, New Delhi, Excel Books.
5. R. Pannerselvam – Research Methodology, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
6. Cooper and Schindler – Business Research Methods, Tata McGraw Hill, 9th Edition.
7. Srivastava and Shailaja – Business Research Methodology, Tata McGral Hill, New Delhi.
8. R.S. Dwivedi – Research Methodology in Behavioural Science, McMillan India Ltd. New Delhi, 2005.

Subject Code-PMG1001	RESEARCH METHODOLOGY	L	T	P	Credits
		04	-	-	04

FOCUS: This course focuses on "Systematic method for acquiring Data and studying it for driving out crucial findings" aligned with CO-1, CO-2, CO-3 & CO-4.

Course outcome: Upon completion of the course subject student shall be able to:

CO1	Acquire knowledge of Literature Review, objectives, types (qualitative and quantitative), concept of Research, Concepts of Research Design.
CO2	Understand the concept of measurement, Sampling- types, size, mean and variance of a sample and Hypothesis testing- null and alternative hypothesis.
CO3	Know Research paper writing and publication- layout of a research paper, impact factor of journals, h-index and i10-index, structure and content, presentation, citing references, styles and types, ethical issues related to publishing.
CO4	Usoftware for paper formatting and statistical analysis (SPSS, MATLAB, Origin and Graph Pad Prism).
CO5	Acquire knowledge of Plagiarism and self-plagiarism, thesis writing – structuring a thesis: scope, outline, methodology, analysis, discussion, writing and citing references.

PRPH-0001 RESEARCH METHODOLOGY

Module No.	Contents	Teaching Hours
I	**Unit-I** Research, concept, objectives, types (qualitative and quantitative), basis of scientificresearch. Research problems – Criteria for selecting a problem, choosing a methodology. Literature review – process, journals, books, patents and proceedingsResearch Ethics and Integrity; Research Design: Concepts, importance, types , experimental design (Randomized, Randomized blockand factorial design).	15

II	**Unit-II** Measurement- concept, problems and levels. Application of probability - variables, normal and binomial distribution; Sampling- types, size, mean and variance of a sample Hypothesis testing- null and alternative hypothesis; Levels of significance; P-value, paired-t test; Analysis of variance - ANOVA, parametric and non parametric test; Correlation coefficient, simple linear regression, Chi-square test.	15
III	**Unit-III** Research paper writing and publication- layout of a research paper, impact factor of journals, h-index and i10-index, structure and content, presentation,.citing references, styles and types, Ethical issues related to publishing, software for paper formatting and statistical analysis (SPSS, MATLAB, Origin and Graph Pad Prism). Plagiarism and self plagiarism, software for detection of plagiarism Thesis writing – structuring a thesis: scope, outline, methodology, analysis, discussion, summary andabstract.Proof reading: Foot noting, end noting, head noting; writing and citing references	15

BOOKS/ REFERENCES:

1. Kothari CR and Garg Gaurav. Research methodology: Methods and Techniques. NewAge International
2. Goyal RC. Research methodology for health professionals. Jaypee
3. Bolton Sanford and Bon Charles. Pharmaceutical Statistics: Practical and ClinicalApplications, CRC Press,
4. Relevant websites

Subject Code-PRPH0001	RESEARCH METHODOLOGY	L	T	P	Credits
		04	-	-	04

FOCUS: This course focuses on "Systematic method for acquiring Data and studying it for driving out crucial findings" aligned with CO-1, CO-2, CO-3 & CO-4.

Course outcome: Upon completion of the course subject student shall be able to:

CO1	Acquire knowledge of Literature Review, objectives, types (qualitative and quantitative), concept of Research, Concepts of Research Design.
CO2	Understand the concept of measurement, Sampling- types, size, mean and variance of a sample and Hypothesis testing- null and alternative hypothesis.
CO3	Know Research paper writing and publication- layout of a research paper, impact factor of journals, h-index and i10-index, structure and content, presentation, citing references, styles and types, ethical issues related to publishing.
CO4	Usoftware for paper formatting and statistical analysis (SPSS, MATLAB, Origin and Graph Pad Prism).
CO5	Acquire knowledge of Plagiarism and self-plagiarism, thesis writing – structuring a thesis: scope, outline, methodology, analysis, discussion, writing and citing references.

PREC-0010 Research and Publication Ethics

Module No.	Contents	Teaching Hours
I	**Unit-I** Philosophy and Ethics 1. Introduction to Philosophy: definition, nature and scope, concept, branches 2. Ethics: Definition, moral philosophy, nature of moral judgments and reactions.	4
II	**Unit-II** Scientific Conduct 1. Ethics with respect to science and research 2. Intellectual honesty and research integrity 3. Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) 4. Redundant publications: duplicate and overlapping publications, salami slicing 5. Selective reporting and misrepresentation of data	11

	Publication Ethics 1. Publication ethics: definition, introduction and importance 2. Best practices/standards setting initiatives and guidelines: COPE, WAME etc. 3. Conflicts of interest 4. Publication misconduct: Definition, concept, problems that lead to unethical behavior and vice versa, types 5. Violation of publication ethics, authorship and contributorship 6. Identification of publication misconduct, complaints and appeals 7. Predatory publishers and journals	
III	**Unit-III (Practice)** Open Access Publishing 1. Open access publications and initiatives 2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies 3. Software tool to identify predatory publications developed by SPPU: UGC-CARE list of journals Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc. Publication Misconduct 1. Group discussions (2 hrs) 2. Subject specific ethical issues, FFP, authorship 3. Conflicts of interest 4. Complaints and appeals: examples and fraud from India and abroad Software tools (2 hrs) Use of reference management software like Mendeley, Zotero etc. and anti-plagiarism software like Turnitin, Urkund RPE 06: Databases and research metrics 1. Databases 2. Indexing databases 3. Citation databases: Web of Science, Scopus etc. 4. Research Metrics 5. Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, CiteScore 6. Metrics: h-index, g-index,i-10 index, altmetrics	15

Note

a. Relevant Case Studies and research papers should be discussed and presented in the class (Background and interest areas of the students should be considered while selecting the Cases).
b. Practical problems should be discussed, analyzed and solved wherever applicable. Students may be exposed to relevant software's like SPSS, MATLAB etc used for Data analysiskeeping in mind the background of the student.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings:

1. Adil E. Shamoo, and David B. Resnik, Responsible Conduct of Research, Oxford University Press
2. Gary Comstock, Research Ethics: A Philosophical Guide to the Responsible Conduct of Research, Cambridge University Press
3. Robin Levin Penslar, Research Ethics: Cases and Materials, Indiana University Press
4. Tony Mayer, and Nicholas H. Steneck, Promoting Research Integrity in a Global Environment, World Scientific Publishing
5. Relevant research papers and articles from reputed Journals

Subject Code-PREC0010	RESEARCH AND PUBLICATION ETHICS	L	T	P	Credits
		02	-	-	02

FOCUS: This course focuses on "Ensuring that research is done in an ethical manner which serves the interest of people groups or society" aligned with CO-1, CO-2, CO-3 & CO-4.

Course outcome: Upon completion of the course subject student shall be able to:

CO1	Acquire knowledge of Philosophy: definition, nature and scope, concept, branches, Ethics
CO2	Understand the concept of Ethics with respect to science and research, Intellectual honesty and research integrity Conflicts of interest, Publication misconduct: Definition, concept, problems that lead to unethical behavior and vice versa, types, Violation of publication ethics, authorship and contributorship
CO3	Identification of publication misconduct, complaints and appeals, Predatory publishers and journals styles and types, ethical issues related to publishing.
CO4	Software tool to identify predatory publications developed by SPPU: UGC-CARE list of journals
CO5	SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies, Use of reference management software like Mendeley, Zotero etc. and anti-plagiarism software like Turnitin, Urkund

PBS 1002 **BIOINFORMATICS AND INSTRUMENTATION**

Module No.	Contents	Teaching Hours
I	Bioinformatics a. Principles of DNA and Protein sequencing, file formats for storage of Sequence and Structural Data, Primary Sequence Databases of Nucleic Acids and Proteins, Organism Specific Genome Databases, Structural Databases. b. Specialized Sequence Databases of Expressed Sequence Tags, Gene Expression, Single Nucleotide Polymorphism, OMIM, Unigene etc., Data Retrieval with ENTERZ, SRG and DBGET, Secondary Databases (Pfam, PROSITE, PRINT, BLOCK etc.)	20
II	**Unit-II** a. Chromatography: Adsorption and partition, theory, preparation, procedure and methods ofdetection, Column, Thin layer chromatography, Paper chromatography. b. Gas chromatography: Introduction, fundamentals, instrumentation, columns, preparation andoperation, detection, dramatization. c. HPLC: Principals and instrumentation, solvent and columns used, detection and applications. d. Electrophoresis. e. Immunoassay Techniques. f. UV-Visible spectroscopy, introduction, electromagnetic spectrum, absorbance laws and limitation, instrumentation design and working principle, chromophore concept, auxochromes, wood-fisher rules for calculating absorption maximum application of UV-visible spectroscopy. g. IR spectroscopy: Basic principles- Molecular vibrations, vibrational frequency, factor influencing vibrational frequencies sampling techniques, instrumentation interpretation of spectra, FT-IR, theory and applications.	20

III	**Unit-III** a. Mass spectroscopy: Theory, ionization technique: electron impact ionization chemical ionization field ionization fast atom bombardment plasma desorption fragmentation process type of fission resolution. b. NMR: Theory, instrumentation, chemical shift, shielding and deshielding effect, splitting of signals, spin-spin coupling, proton exchange reactions, coupling constant (J), ^{13}CNMR spectra and its applications.	20

REFERENCES:

1. Instrumental Method of Chemical Analysis by B.K. Sharma
2. Organic spectroscopy by Y.R. Sharma
3. A Text book of Pharmaceutical Analysis by Kerrenth A. Connors
4. Vogel's Text book of Quantitive Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I.L. Finar Organic spectroscopy by William Kemp
7. Quantitative analysis of drugs by D.C. Garraett
8. Quantitative analysis of Drugs in Pharmaceutical Formulations by P.D. Sethi
9. Spectrophotometric identification of Organic Compound by Silverstein.

Subject Code-PBS1002	**BIOINFORMATICS AND INSTRUMENTATION**	**L**	**T**	**P**	**Credits**
		02	**-**	**-**	**02**

FOCUS: This course focuses on "Data Scientist & Research Analyst" aligned with CO-1, CO-2, CO-3 & CO-4.

Course outcome: Upon completion of the course subject student shall be able to:

CO1	Acquire knowledge of Principles of DNA and Protein sequencing, file formats for storage of Sequence and Structural Data
CO2	Understand the concept of Specialized Sequence Databases of Expressed Sequence Tags, Gene Expression, Single Nucleotide Polymorphism, OMIM, Unigene etc., Data Retrieval with ENTERZ, SRG and DBGET, Secondary Databases (Pfam, PROSITE, PRINT, BLOCK etc.)
CO3	Understand the concept of Chromatography, Electrophoresis. Immunoassay Techniques HPLC: Principals and instrumentation IR spectroscopy
CO4	Knowledge about Mass spectroscopy: Theory, ionization technique, NMR: Theory, instrumentation, chemical shift, shielding and deshielding effect, splitting of signals, spin-spin coupling, proton exchange reactions, coupling constant (J), ^{13}CNMR spectra and its applications.

DISCIPLINE / SPECIALIZATION SUBJECTS

PPS 1003: ADVANCES IN PHARMACEUTICAL SCIENCES

Module No.	Content	Teaching Hours
I	Biodegradable polymers- A study of Natural synthetic and semi synthetic polymers. Factors affecting biodegradation, Mechanism of biodegradation, Applications. Standardization of excipents	20
II	a) Advances in liquid formulation- Multiple emulsions, Micro emulsions, SEDDS, SMEDDS. b) Concept of personalized medicine- need for low & flexible dose products, Fast dissolving, Combination dose systems, Mini tablets, Microdose systems, Implanted devices, Pumps, Microfluidic devices and microchip based technology, Electroactive controlled release films, Telepharmacy, Three dimensional printing.	20
III	a) Nanotechnology based pharmaceuticals – Rationale, Preparation, Characterization, Evaluation and applications. b) Toxicology of Nanoparticles.	20

Books Recommended:

- Chasin M. And Langer R., Biodegradable Polymers as a Drug Delivery Systems, Taylor and Francis, London.
- Ghebre-E., Multiparticulate Oral Drug Delivery, CRC Press, Taylor and Francis, London.
- Florence,A.T. and Siepman, J Modern Pharmaceutics, Volume 1 and 2 ,CRC Press Taylor and Francis, London.
- Junginger E., Drug Targeting & Delivery: Concepts in Dosage Form Design, ,Taylor and Francis, London.
- Hauss E., Oral Lipid-Based Formulations: Enhancing the Bioavailability of Poorly Water-Soluble Drugs ,Taylor and Francis, London.
- Nielloud E., Pharmaceutical Emulsions and Suspensions, Taylor and Francis, London.
- Dinda SC., Advances in Pharmaceutical Technology, PharmaMed press, Hyderabad.
- Thassu D., Nanoparticulate Drug Delivery Systems ,Taylor and Francis, London.
- Gupta RB. And Kompella UB., Nanoparticle Technology for Drug Delivery, Taylor and Francis, London.
- Schreier H., Drug Targeting Technology, Taylor and Francis, London.
- Ottenbrite E., Polymeric Drugs & Drug Delivery Systems, Taylor and Francis, London.
- Rathbone E., Modified-Release Drug Delivery Technology ,Taylor and Francis, London.
- Relevant websites and journals.

Subject Code-PPS 1003	ADVANCES IN PHARMACEUTICAL SCIENCES	L	T	P	Credits
		04	-	-	04

FOCUS: This course focuses on "Research Analyst" aligned with CO-1, CO-2, CO-3, CO-4 & CO-5.

Course Outcome: Upon completion of the course subject student shall be able to:

CO1	Acquire the knowledge of Biodegradable polymers, Factors affecting biodegradation, Mechanism of biodegradation, Applications and standardization of excipients.
CO2	Understandthe concept of liquid formulation- Multiple emulsions, Micro emulsions, SEDDS, SMEDDS.
CO3	Understand the concept of personalized medicine, Fast dissolving, Combination dose systems, Mini tablets, Microdose systems, Implanted devices and pumps.
CO4	Know microfluidic devices and microchip based technology, Electroactive controlled release films, telepharmacy and three dimensional printing.
CO5	Know Nanotechnology based pharmaceuticals and toxicology of Nanoparticles.

PPS1002: Current Approaches in Advanced Pharmacology

Module No.	Content	Teaching Hours
I	Autonomic Nervous system: Advances in the pharmacology of sympathomimmetics, sympatholytics, parasympathomimmetics and parasympatholytics. Central Nervous system: Advancement in the Pharmacology of anxiolytics, antidepressants, antiparkinson, anti-alzheimer, anti-psychotics, and anti-epileptic drugs. Cardiovascular system: Advance in the pharmacology of cardiotonics, antihypertensive, anti-ischemic and anti-arrhythmics Endocrine system: Recent advances in pharmacology of Insulin,thyroid, Estrogen and progesterone	20
II	Recent advances in pharmacology of apoptosis, GSK-3β, Rho kinase and caveolin.	20
III	Advances in the pharmacology of angiotensin, kinase, cannabinoids,NMDA, Opoid, purinergic and vanilloid receptor. Stem cell biology	20

Books Recommended:

- The Pharmacological Basis of Therapeutics, Goodman and Gillman's
- Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.
- Basic and Clinical Pharmacology by B.G Katzung
- Modern Pharmacology with Clinical Applications, Craig Charles R. & Stitzel Robert E.,Lippincott publishers.
- Clinical Pharmacokinetics & Pharmacodynamics : Concepts and Applications – MalcolmRowland and Thomas N.Tozer, Wolters Kluwer,
- Modern Pharmacology, Craig CR. & Stitzel RE, Little Brown & Company.

Relevant websites and journals.

Subject Code-PPS1002	**CURRENT APPROACHES IN ADVANCED PHARMACOLOGY**	**L**	**T**	**P**	**Credits**
		04	**-**	**-**	**04**

FOCUS: This course focuses on "Pharmacovigilance" aligned with CO-1, CO-2, CO-3 & CO-4.

Course Outcome: Upon completion of the course subject student shall be able to:

CO1	Acquire knowledge of advances in pharmacology of drugs affecting autonomic nervous system and central nervous system
CO2	Understand the pharmacology of cardiotonics, antihypertensive, anti-ischemic and anti-arrhythmics.
CO3	Know the recent advances in pharmacology of Insulin, thyroid, Estrogen and progesterone
CO4	Understand the pharmacology of apoptosis, GSK-3β, Rho kinase and caveolin.
CO5	Understand the pharmacology of angiotensin, kinase, cannabinoids, NMDA, Opoid, purinergic and vanilloid receptor.

PPS1004: Pharmacognosy & Phytochemistry

Module No.	Content	Teaching Hours
I	**Cultivation Technology** Profiles for commercial cultivation technology and post harvest care of Ashwagandha, Dioscorea, Isapgol, Ginger, Turmeric, Aloes, Digitalis, Catharanthus, Senna, Papaya, Lemongrass, Peppermint.	16
II	**Recent developments in the research on Natural medicinal products including Drug Discovery**: Introduction, Isolation and characterization of the following Phytopharmaceutical groups: Alkaloids, Volatile oils, Glycosides, Tannins and Flavonoids,. **b**. Basic principles of Ayurveda, salient features of techniques of preparation and standardization of traditional formulations as per Ayurvedic Pharmacopoeia.	22
III	**a. Modern methods of assay and Standardization of herbal phytoconstituents, drugs and formulations:** Conventional methods and Modern techniques of assay of Andrographolids, Asiticosides, Solasodine, Bacoposide, Curcumin, Digitoxin, Glycyrrhitinic Acid, Kutkoside, Taxol and Withaferin. **b.** General methods of screening of natural products for following biological activity: a) Anti-inflammatory and analgesic, b) Hypoglycaemic, c) CNS Screening d) Hepato protective, e) Antioxidant.	22

Reference Books:

- Wallis, T.E. Text Book of Pharmacognosy, CBS Publication, New Delhi, 1985.
- Trease & Evans, W.C., Pharmacognosy, 15th Ed., Saunders, Elsevier.
- WHO Guidelines.
- Herbal Pharmacopoeia.

- Mukherjee P. K. Quality Control of Herbal Drugs, Business Horizons; edition, May 2002, Reprint 2012
- John P. Devlin. High Throughput Screening: The Discovery of Bioactive Substances, CRC Press, 1997.
- Turner R.A., Hebborn P. Screening methods in Pharmacology, vol.I, Academic press, Elsevier, 2009.
- Ayurvedic Pharmacopoeia.
- Atal C.K., Kapur B.M., Cultivation and utilization of Medicinal Plants, Jammu-Tawi : Regional Research Laboratory, Council of Scientific & Industrial Research, 1982.
- Gupta S.K. Drug Screening methods, III edition, Jaypee brother medical publisher (P) Ltd. 2016.
- Kalia, A.N. Textbook of Industrial Pharmacognosy, CBS Publishers & Distributors Pvt. Ltd. New Delhi, 2011.

Subject Code-PPS 1004	**PHARMACOGNOSY AND PHYTOCHEMISTRY**	**L**	**T**	**P**	**Credits**
		04	**-**	**-**	**04**

FOCUS: This course focuses on "Herbal Formulations" aligned with CO-1, CO-2, CO-3 & CO-4.

Course Outcome:

Upon completion of the course subject student shall be able to:

CO1	Acquire the knowledge of commercial cultivation technology and post-harvest care of Ashwagandha, Dioscorea, Isapgol, Ginger, Turmeric, Aloes, Digitalis, Catharanthus, Senna, Papaya, Lemongrass, Peppermint.
CO2	Understand the concept ofIsolation and characterization of Alkaloids, Volatile oils, Glycosides, Tannins and Flavonoids.
CO3	Know the basic principles of Ayurveda, techniques of preparation and standardization of Ayurvedic formulations.
CO4	Understand the modern techniques of assay of Andrographolids, Asiticosides, Solasodine, Bacoposide, Curcumin, Digitoxin, Glycyrrhitinic Acid, Kutkoside, Taxol and Withaferin.
CO5	Know the screening of natural products for Anti-inflammatory and analgesic, Hypoglycaemic, CNS activity, Hepato protective and Antioxidant activities.

PPS1001: Advances in Organic Chemistry

Module No.	Content	Teaching Hours
I	Optical and Geometrical Isomerism Atropisomerism, Configuration and Confirmation. stereo-selective synthesis and stereo-regulated polymerization	15
II	Aromatic electrophilic substitution, Aliphatic nucleophilic Substitution and Aromatic nucleophilic substitution. Free radical reactions, Elimination reactions and addition to carbon-carbon multiple bonds.	20
III	Selected named reactions with their synthetic importance.	25

Subject Code-PPS1001	ADVANCES IN ORGANIC CHEMISTRY	L	T	P	Credits
		04	-	-	04

FOCUS: This course focuses on "Research & Development" aligned with CO-1, CO-2, CO-3 & CO-4.

Course Outcome: Upon completion of the course subject student shall be able to:

CO1	Understand the concepts of Optical and Geometrical Isomerism, Atropisomerism, Configuration and Confirmation.
CO2	Know the stereo-selective synthesis and stereo-regulated polymerization.
CO3	Understand Aromatic electrophilic substitution, Aliphatic nucleophilic Substitution and Aromatic nucleophilic substitution.
CO4	Acquire knowledge of Free radical reactions, Elimination reactions and addition to carbon-carbon multiple bonds.
CO5	Understand the concepts of selected named reactions with their synthetic importance.

COURSE STRUCTURE

BACHELOR OF EDUCATION

(B.Ed.)

Credits Distributions

Sr. No.	Category	No. of Credits
1	Core Course	30
2	EPC	26
3	Program Core	38
Total		**94**

First Semester

S. NO.	COURSE CATEGORY	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
				L	T	P		
1	CC	EDB 1001	Childhood & Growing Up	4	1	0	5	5
2	CC	EDB1002	Contemporary India & Education	4	1	0	5	5
3	PC	EDB1003	Language Across The Curriculum	4	1	0	5	5
4	PC	EDB 1004	Understanding Disciplines And Subjects	3	0	0	2	3
PRACTICALS								
5	EPC	EDB 1080	Drama, Art & Aesthetics	0	0	2	2	4
6	EPC	EDB 1081	Health and Physical Education	0	0	2	2	4
7	EPC	EDB 1082	Strengthening Language Proficiency	0	0	2	2	4
8	EPC	EDB 1083	Understanding ICT and Its Application-I	0	0	3	3	6
			TOTAL	**15**	**3**	**9**	**26**	**36**

Second Semester

S. NO.	COURSE CATEGORY	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
				L	T	P		
1	CC	EDB 2001	Knowledge and Curriculum	4	1	0	5	5
2	CC	EDB 2002	Learning and Teaching	4	1	0	5	5
	PC		**Pedagogy of School subjects- (Choose any two)**				**6**	**6**
3	PC	EDB 2003	Pedagogy of Hindi	3	0	0	3	3
4	PC	EDB 2004	Pedagogy of English	3	0	0	3	3
5	PC	EDB 2005	Pedagogy of Sanskrit	3	0	0	3	3
6	PC	EDB 2006	Pedagogy of Science	3	0	0	3	3
7	PC	EDB 2007	Pedagogy of Biology	3	0	0	3	3
8	PC	EDB 2008	Pedagogy of Mathematics	3	0	0	3	3
9	PC	EDB 2009	Pedagogy of Social Science – I (History, Civics)	3	0	0	3	3
10	PC	EDB 2010	Pedagogy of Social Science – II (Economics, Geography)	3	0	0	3	3
11	PC	EDB 2011	Pedagogy of Commerce	3	0	0	3	3
12	PC	EDB 2012	Pedagogy of Home Science	3	0	0	3	3
PRACTICALS								
13	EPC	EDB 2080	Reading & Reflecting Text	0	0	2	2	4
14	EPC	EDB 2081	Scouting & Guiding	0	0	2	2	4
15	EPC	EDB 2082	Understanding ICT and Its Application-II	0	0	3	3	6
16	EPC	EDB 2083	Yoga Education	0	0	2	2	4
			TOTAL	**14**	**2**	**9**	**25**	**34**

Third Semester

S. NO.	COURSE CATEGORY	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
				L	T	P		
PRACTICALS								
1	PC	EDB 3080	School Internship				18	96/16
			Total				**18**	**96/16**

Fourth Semester

S. NO.	COURSE CATEGORY	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
				L	T	P		
1	CC	EDB 4001	Creating an Inclusive School	4	1	0	5	5
2	CC	EDB 4002	Gender, School & Society	4	1	0	5	5
3	PC	EDB 4003	Assessment for Learning	4	1	0	5	5
	PC		**Optional Course (Choose anyone from the following)**	**3**	**0**	**0**	**2**	**3**
4		EDB 4004	Environmental Education	3	0	0	2	3
5		EDB 4005	Peace Education	3	0	0	2	3
6		EDB 4006	Population Education	3	0	0	2	3
7		EDB 4007	School Administration and Management	3	0	0	2	3
8		EDB 4008	Value Education	3	0	0	2	3
PRACTICALS								
9	EPC	EDB 4080	Soft Skills & Personality Development	0	0	6	3	6
10	EPC	EDB 4081	Understanding ICT and Its Application-III	0	0	6	3	6
11	EPC	EDB 4082	Working with Community	0	0	4	2	4
			TOTAL	**15**	**3**	**16**	**25**	**34**

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
THEORY									
1	EDB 1001	Childhood & Growing Up	4	1	0		5	5	
2	EDB1002	Contemporary India & Education	4	1	0		5	5	
3	EDB 2001	Knowledge and Curriculum	4	1	0		5	5	
4	EDB 2002	Learning and Teaching	4	1	0		5	5	
5	EDB 4001	Creating an Inclusive School	4	1	0		5	5	
6	EDB 4002	Gender, School & Society	4	1	0		5	5	
Total			**24**	**6**	**0**	**-**	**30**	**30**	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet:									
THEORY									
1	EDB 4004	Environmental Education	3	0	0		2	3	
2	EDB 4005	Peace Education	3	0	0		2	3	
3	EDB 4006	Population Education	3	0	0		2	3	
4	EDB 4007	School Administration and Management	3	0	0		2	3	
5	EDB 4008	Value Education	3	0	0		2	3	
		Total	**3**	**0**	**0**		**2**	**3**	

FIRST SEMESTER

EDB 1001: Childhood & Growing Up

Objective: *The course will enable the student-teachers to understand child and adolescence development and growth, its theoretical perspectives, dimensions and stages, cognitive processes and affective processes in a socio-cultural context.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Child Development** 1.1 Growth & Development: - Concept, Principle, Factors, & Stages. 1.2 Characteristics of stages of development with special reference to Childhood and Adolescence. 1.3 Adolescents: Understanding their needs and Problems in Indian context.	20
UNIT II	**Theories of Child Development** 2.1 Theory of Cognitive Development by Piaget: Concept, Stages and Implications with special reference to Indian Context. 2.2 Theory of Social & Emotional Development by Erickson: Concept, Stages and Implications with special reference to Indian Context. 2.3 Kohlberg theory of Moral Development: Concept, Stages and Implications with special reference to Indian Context.	20
UNIT III	**Social Contexts of Development** 3.1 Agencies of Socialization: Family, School, Society and their role in Child Development. 3.2 Social and Cultural Change and their Impact on child development. 3.3 Economic Change :Impact of urbanization and Economic change on child development	20
UNIT IV	**Contemporary Issues** 4.1 Marginalization & Stereotyping with special reference to Gender, Social Class, Poverty. 4.2 Impact of marginalization & Stereotyping on child development and related outcomes. 4.3 Role of media in constructing & deconstructing perceptions & ways of dealing with above issues.	20

Practicum/Internal work: (any one)

- Case-study of an adolescent: Problems and Needs.
- Seminar/ Presentation on educational implications of One Learning theory of child development.
- Survey report on impact of socio-economic status of a family on child.
- Content Analysis of Media coverage on the following:
    a. Child labour.
    b. Gender bias.
    c. About Disability.

Reference Books:

- Backett Chris (2004), Human Growth & Development, Sage Publication
- Das, J. P. (1998), The Working Mind: An Introduction to Psychology, SagePublication.
- Chomskey, N. (1968), Language and Mind, Harcourt Brace, Jovanobich.
- Singh Indramani & Parasuraman, Raja (1998) Human Cognition - A Multi-Disciplinary Perspective, Sage Publication.
- Baddeley, A. D. (1996) Human Memory : Theory and Practice, Washington, DC: Psychology Press.
- Gruneberg, M. M.; Marris, P.E. & Skyes, R.N. (1998) (Eds) Practical aspects of memory; Current research and issues (Vol.2) John Wiley, New York.
- Brown J. (1976), Recall and recognition, London.
- Piaget, J. (1970), Science of Education and The Psychology of child, New York :Orion Press.
- Hurlock, Elizabeth B. (2007), Child Development, Tata Mc Grow-Hill Publishing Company Ltd. New Delhi
- गुप्ता, एस.पी., गुप्ता, अलका, 1/420071/2, उच्चतर शिक्षा मनोविज्ञान, शारदा पुस्तक भवन, इलाहाबाद
- पाठक, पी.डी., 1/420071/2, शिक्षा मनोविज्ञान, विनोद पुस्तक मंदिर, आगरा
- मंगल, एस.के.,1/420081/2,शिक्षा मनोविज्ञान, प्रिंटिस हॉल ऑफ इण्डिया प्राइवेट लिमिटेड,नईदिल्ली
- मूरजानी जानकी, नारंग, दर्शन कौर एवं मणिका मोहन, बाल विकास का मनोविज्ञान,अपोलो प्रकाशन, जयपुर
- यादव, सियाराम, 1/420081/2,अधिगमकर्ता का विकास एवं शिक्षण अधिगम प्रक्रिया, शारदापुस्तक भवन, इलाहाबाद

Focus: This Course is employable under the CO1, CO2 and CO3

Outcome:

After completion of this course the student teacher will able:

CO1: To explain the concept of growth & development in relation to characteristics of various stages of growth & development.

CO2: To become familiar with theories of child development and their educational implications.

CO3: To understand the role of family, school, society in child development.

CO4: To describe the role of contemporary issues (issue of marginalization: class, poverty, gender, issues of urbanization and economic change) in child development.

CO5: To describe the role of media in deconstruction of significant events.

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

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1, PSO4
CO2	PO1,PO3 /PSO1
CO3	PO2, PO3 /PSO1, PSO4
CO4	PO5,PO7 /PSO1
CO5	PO4, PO7 /PSO2, PSO3

EDB1002: Contemporary India & Education

Objective: *The course will enable the student teachers to acquire knowledge about the salient features of our Constitution, constitutional measures and policies to protect diversities issues, and challenges faced by Indian contemporary Society.*

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

Module No./ Unit	Content	Teaching Hours
UNIT I	**Concept of Education** 1.1 Meaning, Aims, Objectives and function of education. 1.2 Education in the Indian context with reference to Swami Vivekananda, Mahatma Gandhi, J. Krishnamurti – Educational thoughts. 1.3 Overviews of Educational Schools (Indian & Western) - Idealism, Naturalism and pragmatism Sankhya, Yoga And Vedanta.	30
UNIT II	**Educational Policy Perspectives** 2.1 Overview of Education Commissions and Government bodies. 2.1.1 Kothari Commission 2.1.2 NPE. 1986 2.1.3 NCERT 2.1.4 NCTE 21.5 UGC 2.2 National knowledge commission report - Recommendations on school education. 2.3 Education for national and emotional integration.	20
UNIT III	**Issues and Challenges of Education in India.** 3.1 Education for disadvantaged group. 3.2 Right to Education Act 2009 3.3 Sarva Shiksha Abhiyan and Mid day Meal Programme 3.4 Rashtriya Madhyamik Shiksha Abhiyan 3.5 Education as related to social equity and equality of educational opportunities	20
UNIT IV	**Indian Constitution and Directive Principles**. 4.1 Universalization of Education. 4.2 Constitutional values related to aims of education. 4.5 Constitutional promise of freedom, justice, equality and fraternity.	10

Practicum Works: (Any one)

- Write the educational contribution of any one Indian Thinker.
- Prepare a term paper on how we can inculcate values in the present system of education.
- Prepare a structure of education since ancient period to present time.
- Write the comparison on education system in Indian and Western School

Reference Books:

- Crown, R.G. (1965),A Society of Education, Engineering patterns of class, status and power in the public school, New York : Appleton-century crofts.
- Durkhem, S. (1956), Education and Sociology of Education, New York : The Free Press of Glenoce. .
- Gore, M.S., et. al. (1967), Papers in the sociology of Education in India, New Delhi, NCERT.

- Hanseu, D.A. et. al (1965), On Education : Sociological Perspective. New York :John Wiley and Sons
- चौबे, सरयूप्रसाद, (2005), शिक्षा के समाजशास्त्रीय आधार, विनोद पुस्तक मंदिर, आगरा
- त्रिपाठी, शालिग्राम, (2008), शिक्षा सिद्धान्त, कनिष्क पब्लिशर्स डिस्ट्रीब्यूटर्स, अंसारी रोड़, नई दिल्ली
- पाण्डेय, रामशक्ल, (2008), उभरते हुए भारतीय समाज में शिक्षा, विनोद पुस्तक मंदिर, आगरा
- पाठक, पी. डी., (2008), भारतीय शिक्षा और उसकी समस्याएँ, विनोद पुस्तक मंदिर, आगरा
- पाठक एवं त्यागी, (2008), शिक्षा के सिद्धान्त, विनोद पुस्तक मंदिर, आगरा
- पाण्डेय, रामशक्ल, (2007), शिक्षा के मूल सिद्धान्त, विनोद पुस्तक मंदिर, आगरा
- शर्मा, आर. पी., गुप्ता शोभा, (2008), उभरते हुए भारतीय समाज में शिक्षा, विनोद पुस्तक मंदिर, आगरा
- सिन्हा, मंजरी, सिन्धु, आई. एस., (2007), विकासोन्मुख भारतीय समाज में शिक्षा तथा शिक्षक की भूमिका, विनोद पुस्तक मंदिर, आगरा

Focus: This Course is employable under the CO1, CO2 and CO3

Outcome:

After completion of this course the student teacher will able:

CO1: To know philosophical aspects of education and develop educational perspective.
CO2: To understand the concept, principle of sustainable development and core concept of Educational thinkers.
CO3: To understand knowledge of the Indian education system as it has evolved from the past, as it is today.
CO4: To solve prevailing problems of education in India.
CO5: To know social equity and equality of educational opportunities.
CO6: To understand the purpose, function and Role of education in nation building

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs): (Data in red colour is just a sample)

COs	POs/ PSOs
CO1	PO1 /PSO4
CO2	PO5, /PSO1
CO3	PO2, PO5 /PSO1, PSO4
CO4	PO7,PO8 /PSO1, PSO2, PSO4
CO5	PO7,PO8 /PSO1, PSO2, PSO4
CO6	PO10 /PSO1, PSO3

EDB 1003: Language Across the Curriculum

Objective: *The course will enable the student teachers to understand the language background of students and nature of classroom discourse. Also understand the importance and role of language for content areas.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Language Acquisition and Development** **1.1** Language: Concept, meaning and nature. Language uses: Oral and written. **1.2** Three language policy: (mother tongues and regional languages, national pride and unity (Hindi), and administrative efficiency and technological progress (English). Merits and Demerits of the Three-language Formula. **1. 3** Speech and Writing Language and Society Language and Identity. **1.4** Language development: From childhood to Adult stages.	20
UNIT II	**Language Skills** **2.1** Reading: Silent reading vs. Rapid reading, News Paper, Journal, Books. **2.2** Narrative Text vs. Expository text. **2.3** LSRW (Listening, Speaking, Reading, Writing). **2.4** Note making and creative writing (Essay, Application, Letter, Paragraph).	20
UNIT III	**Language & Classroom Interaction** **3.1** Expression: Public Speech, Lecture, Debating. **3.2** Multilingualism in classroom. **3.3** Schema theory. **3.4** Errors and Correction of Language in class.	20
UNIT IV	**Nature of Class Room Discourse** **4.1** Oral Language; discussion as a tool for learning. **4.2** The nature of questioning the classroom, types of questions and teacher's role. **4.3** Language phonemes and identification of sound errors. **4.4** Disciplinary language: (Social science, general science, math etc.).	20

Practicum/Internal Work: (Any One)

- Identify speech defect in classroom teaching and prepare a Chart
- Prepare a Report on Creative Writing
- Prepare a Presentation on communication (30 minutes) Skill.
- Prepare a chart on Phonetics Symbols

Reference Books:

- Baruah, T.C. (1985), The English Teacher's Handbook, New Delhi, Sterling Publication Pvt. Ltd.
- Lado, Robert (1971), Language Teaching, New Delhi, Tata Mc. Grew Hill Pub. Co. Ltd.
- Richards, J.C. and Rodgers, T.S. (2000), Approaches and Methods in Language Teaching, Cambridge, CUP.
- Datt, Ruddar (1985), Distance Education in India, Open School, New Delhi
- Hillard, R. I., Writing for T.V. and Radio, N.Y. Hastings House
- Parmaji, S. (1984), Distance Education, Sterling Publication, New Delhi
- यादव, सियाराम (2008), दूरवर्ती शिक्षा, विनोद पुस्तक मंदिर, आगरा

- Freeman Diane-Larsen (2000) Techniques and principles in language teaching.
- David Corson ,Oral Language Across the Curriculum
- Little wood, W. 1981. Communicative Language Teaching. Cambridge: Cambridge University Press.
- Mohanty, Ajit K. 1994. Bilingualism in a Multilingual Society:
- Psycho–social and Pedagogical Implications. Mysore: CIIL
- Narasimha Rao, K.V.V.L. and K.P. Acharya . 1992. A
- Bibliography of Language Teaching Arts: Studies Done in Indian
- Universities and Research Institutions. Mysore: CIIL
- Nunan, D. 1989. Understanding Language Classrooms. Prentice Hall.
- Nunan, D. 1991. Language Teaching Methodology. London: Prentice Hall
- Agnihotri, R.K. & Sharma, A.L.: English Language Teaching in India – Issues & Innovations
- Allen, H.B. &Campbell, R.P.: Teaching of English as a Second Language
- Chaudhary, N.R.: Teaching English in Indian Schools
- Frishy, A.C.: Teaching English
- Ho;rnby, A.C.: Teaching of Structural Words
- Mukalel, J.C.: Approaches to English Language Teaching

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5, CO6 and CO7

Outcome:

After completion of this course the student teacher will able:

CO1: To understand the nature and use of language.

CO2: To develop the idea of Multilingualism in class room teaching.

CO3: To create the sense of language and its flavor.

CO4: To inculcate language skills among trainees.

CO5: To evaluate skills creative writing and expression.

CO6: To acquire the idea of composition and art of writing i.e. letter, Paragraph, application etc.

CO7: To develop ornamental use of vocabulary in different curriculum.

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

COs	POs/ PSOs
CO1	PO5,PO6,PO8 /PSO1, PSO2, PSO3
CO2	PO10 /PSO10
CO3	PO3,PO5 /PSO1, PSO2, PSO3
CO4	PO5,PO6,PO8 /PSO1, PSO2, PSO3
CO5	PO5,PO6,PO8 /PSO1, PSO2, PSO3
CO6	PO9 /PSO1
CO7	PO5,PO6,PO8 /PSO1, PSO2, PSO3

EDB 1004: Understanding Disciplines and Subjects

Objective: *The course will enable the student teachers to understand the nature, changes in disciplines and subjects in terms of social, Political and Intellectual contexts, 'disciplinary role' and relationship between academic disciplines and relationship between academic disciplines and school subjects.*

Credits: 02 **L-T-P-J: 3-0-0-0**

Module No./Unit	Content	Teaching Hours
UNIT I	**Structure of the Disciplines** 1.1 Disciplines: Meaning, Types and Importance 1.2 Core ideas of Developing Discipline: Meaning and organization 1.3 Philosophical views in different disciplines by John Dewey Rammohan Roy and J.Krishnamurti in modern context.	16
UNIT II	**Understanding the Organization of School Subjects** 1.1 Nature, importance and historical perspective of Science, Social Science, Mathematics and Languages. 1.2 Changes in school subjects in terms of social, political and intellectual context. 1.3 Curriculum: Concept, Principles of curriculum construction.	16
UNIT III	**Analyzing relationship between school Subjects.** 1.1 Correlation among different school subjects (Science, Social Science, Mathematics and Languages) and its effects on curriculum framework. 1.2 Meaning of inter disciplinary approach to education and its effects on school subjects. 1.3 Criterion of content for selection of school subjects in view of objectives and sources.	16

Practicum/Internal work:

- Preparation of written report on Comparative analysis of any two disciplines and their branches (like natural sciences, humanities, social sciences, science, Bio sciences, and their branches etc.)
- Write the Philosophical views of John Dewey for inter disciplinary area of School subject
- Write the views of any one Indian Educationist on curriculum.

Reference Books:

- Butchvarov,P. (1970), The concept of Knowledge, Evanston, Illinois: Western University Press.
- Debra H. Martin,H. Pam C. & Lingard,B. (2007), Teachers and Schooling: making a difference. Australia: Allen and Unwin.
- Gardner,H. (1993), Creating Minds, New York: Basic Books.
- Noddings,N. (2007), Critical Lessons: What our schools should teach, Cambridge University Press.
- Ornstein,Allen C.,Edward F.P.& Stacey B.O.(2006) Contemporary issues in curriculum, Allyn & Bacon.
- Bruner, J.S. ((2006) In Search of Pedagogy, Vol-I &II, (he selected works), London: Routledge.

- Kneller, G.F.,(1963) Foundations of Education, London and New York: John Wiley & Sons, Inc.
- NCERT (2005), National Curriculum Framework, New Delhi.

Focus: This Course is focusing on employability and skill development under the CO1, CO2 and CO3

Outcome:

After completion of this course the student teacher will able:

CO1: To reflect on the nature and 'disciplinary role' in the school curriculum.

CO2: To understand the nature, changes in disciplines and subjects in terms of social, Political and Intellectual contexts.

CO3: To study the relationship between academic disciplines and school subjects.

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

COs	POs/ PSOs
CO1	PO3 /PSO2
CO2	PO7,PO10 /PSO1, PSO4
CO3	PO7,PO10 /PSO1, PSO4

EDB 1080: Drama, Art & Aesthetics

Credits: 02 ***L-T-P-J: 0-0-2-0***

Objective:

The course will enable the student teachers to understand basics of different art forms, artistic and aesthetic sensibility among learners to enable them to respond to the beauty in different art forms, through genuine exploration, experience and free expression also acquire skills for integrating different art forms across school curriculum for better learning and development.

Module No./Unit	Content	Teaching Hours
UNIT I	**Performing Arts: Dance, Music, Theatre and Puppetry (Practicum activities)** Listening/viewing and exploring Regional Art forms of music, dance, theatre and puppetry live and recorded performances of Classical and Regional Art forms. Participation and performance in any one of the Regional Arts forms keeping in mind the integrated approach also Planning a stage-setting for a performance/presentation by the student-teacher. • Different theatre games, Exercises, Martial Arts, Folk Dances (Body Movement). • Script Writing- characterization, dialogue, time and space, beginning, middle, end. • Poetry writing & recitation. • Dramatization on various Historical, Political, Educational themes. • Building of a Character by the role play. • Parts of Speech- Volume, Pitch, Speed, clarity, Audibility, Diction, Intonation, Feel and Toner Quality, Projection.	32
UNIT II	**Visual Arts and Crafts (Practicum activities):** Experimentation with different materials of Visual Art, such as pastel, poster, pen and ink, rangoli materials, clay, Painting, block printing, collage, clay modeling, paper cutting and folding, Paper framing and display of Art works. The student-teachers may be asked to prepare at least 5-items of different categories – • Paper meshing • Pot Decoration • Wall hanging • Paper cutting • Flower making • Candle Making • Stitching • Knitting/Embroidery • Soft toys making • Paper framing • Weaving or printing of textiles • Making of Rangoli • Making of Puppets etc.	32

Reference Books:

Focus: This Course is focusing on skill development under the CO1, CO2, CO3, CO4 & CO5

Outcome:

After completion of this course the student teacher will able:

CO1: To develop basic understanding of different Art forms and impact of Art forms on the human mind.

CO2: To enhance artistic and aesthetic sensibility of learners to enable them to respond to the beauty in different Art forms, through genuine exploration, experience and free expression.

CO3: To develop skills for integrating different Art forms across school curriculum at secondary level.

CO4: To create awareness of the rich cultural heritage, artists and artisans.

CO5: To develop motor skill Make students believe in the dignity of labor.

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

COs	POs/ PSOs
CO1	PO1,PO5,PO9,PO10 /PSO1, PSO2,PSO3,PSO4
CO2	PO1,PO5,PO9,PO10 /PSO1, PSO2,PSO4
CO3	PO1,PO5,PO9,PO10 /PSO1,PSO3,PSO4
CO4	PO1,PO5,PO9,PO10 /PSO1, PSO2,PSO4
CO5	PO1,PO5,PO9,PO10 /PSO1, PSO2,PSO3

EDB 1081: Health and Physical Education

Objective: *The course will enable the student teachers to develop positive attitude towards health and physical education as individual; sensitize, motivate and help them to acquire the skills for physical fitness, learn correct postural habits and activities for its development.*

Credits: 02 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
UNIT I	**Health Education** 1. Health education: Need and Importance 2. Balance diet and Nutrition 3. Personal Hygiene 4. School Health Programme	32
UNIT II	**Physical Education and Sports** 1. Need and Importance of Physical Education and Sports 2. Types of Sports/Games (Minor and Major games) 3. Minor- Recreational games, Major- (Athletics, badminton, Basketball, Cricket, Football, Kho-kho, Volleyball) 4. Competitions-Intramurals and Extramural. 5. Leadership and Camping	32

Reference Books:

- Bucher, C. A. (1964). Foundations of Physical Education, New York: Mosby & Company
- Kilander, H. F. (1971). School Health Education, New York: Mac Millan Company
- Manjul, J. U. S. (1965). School Swasthya Shiksha, Agra University: Universal Publisher
- Rice.E.A.;A brief history of physical education, A5 bornes company, new York.
- Sukhiya S.P. - Educational management & Health Education Singh R.P. - Health Education
- Sharma.Rama; Sharirik shiksha, Agarwal publication, Agra.

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3 & CO4

Outcome:

After completion of this course the student teacher will able:

CO1: Introduce the student teacher with the concept of holistic health and various dimension and determinants of health.

CO2: Acquaint them to school health programmed its importance.

CO3: Sensitize the student teacher towards physical fitness & its importance.

CO4: Help them acquire the skills for assessment of physical fitness.

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

COs	POs/ PSOs
CO1	PO1,PO9,PO10 /PSO1, PSO4
CO2	PO1,PO9,PO10 /PSO1, PSO4
CO3	PO1,PO9,PO10 /PSO1, PSO4
CO4	PO1,PO9,PO10 /PSO1, PSO4

EDB 1082: Strengthening Language Proficiency

Objective: *The course will enable the student teachers to* Strengthen the ability to read correctly, pronunciation, write correctly and communicate correctly.

Credits: 02 **L-T-P-J: 0-0-2-0**

Module No./Unit	Content	Teaching Hours
	हिन्दी भाषा (1) वर्ण–स्वर व व्यंजन ध्वनि, मात्राएं (2) शब्द – पर्यायवाची व विलोम शब्द (3) शब्द रचना–सन्धि, समास, उपसर्ग, प्रत्यय (4) रूप विचार– संज्ञा, सर्वनाम, विषेषण, क्रिया क्रियाविषेषण, आदि (5) वाक्य विचार–विराम चिन्ह, आदि (6) रचना–पत्र, प्रार्थना पत्र, निबन्ध कहानी आदि।	32
	English Language – 1. Alphabet-Vowel & Consonants sounds word-synonyms & Antonyms 2. Word Formation 3. Parts of Speech – Noun, Pronoun, Adjective, Verb, Adverb, etc. 4. Sentence – Punctuation & Analysis 5. Composition-Letter, Application, Essays, Story, etc.	32

Reference Books:

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3 & CO4

Outcome:

After completion of this course the student teacher will able:

CO1: Strengthen the ability to read correctly.

CO2: Strengthen the ability to pronunciation.

CO3: Strengthen the ability to write correctly.

CO4: Strengthen the ability to communicate correctly Activities.

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

COs	POs/ PSOs
CO1	PO1,PO3,PO5,PO6,PO8,PO9/PSO1, PSO2,PSO3
CO2	PO1,PO3,PO5,PO6,PO8,PO9/PSO1, PSO2,PSO3
CO3	PO1,PO3,PO5,PO6,PO8,PO9/PSO1, PSO2,PSO3
CO4	PO1,PO3,PO5,PO6,PO8,PO9/PSO1, PSO2,PSO3

EDB 1083: Understanding ICT and Its Application-I

Objective: *The course will enable the student teachers to focuses on moving beyond computer literacy and ICT-aided learning, to help student-teachers interpret and adapt ICTs in line with educational aims and principles. It explores ICTs along three board strands; teaching-learning, administrative and academic support systems, and broader implications for society. The course will help student-teachers reflect critically and act responsibly to prevent use of ICTs to support centralization of larger knowledge structures; it will show student-teachers how ICTs can be adapted to support decentralized structures and processes; as well as build the ‗digital public' to make education a participatory and emancipatory process.*

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

Module No./Unit	Content	Teaching Hours
	ICT Fundamental & MS- Word • Computer Fundamental Instructions on operating the Computer • Connecting of all peripherals to CPU for a system • Switching on/off/restart • Inserting/removing a CD/DVD from the CD/DVD-ROM drive • Running a file from a CD/DVD-ROM using CD/DVD-ROM drive • Copying files from one drive to another • Creating a new folder • Connecting the printer and print out hard copies • Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file, creating and operating on a folder. • Introduction to all properties such as changing settings like, date, time, calculator, color (back ground and fore ground) • Installing a computer system by giving connection and loading the system software and application software and various sources to install software • MS- word - Menus & Command • MS- word - Toolbars & Buttons • MS- word - Shortcut Menus, • MS- word -Creating a new Document, Saving and Opening documents in Word • MS- word -Selecting, Inserting, Deleting, Moving Text, • MS- word -Previewing documents Different page views and layouts • MS- word -Working with – Styles, Text attributes • MS- word - Paragraph and Page Formatting • MS- word -Text Editing using various features- Bullets, • MS- word – Numbering • MS- word - Formatting Documents • MS- word -Paragraph formats • MS- word -Aligning Text and Paragraph, • MS- word -Borders and Shading • MS- word -Headers and Footers • MS- word -Multiple Columns • MS- word -Find and Replace • MS- word -Checking the Grammar and Spelling • MS- word -Formatting via find and replace, • MS- word -tables and charts, • MS- word -Printing and Various Print options	96

Reference Books:

- Cox, J. & Urban, P. (1999). Quick Courses in Microsoft Office, New Delhi: Galgotia Publications.
- Jain, Satish. (1990). Introduction to Computer Science and Basic Programming, New Delhi: Prentice Hall of India.
- Saxena, S. (1998). A first Course in Computer, New Delhi: Vikas Publications.
- Sinha, P.K. (1990). Computer Fundamentals, New Delhi: BPB Publications.
- Tanenbaum, A.S. (1998). Computer Networks, New Delhi: Prentice-Hall of India.
- Intel (2003). Intel Innovation in Education, New Delhi: Student Work Book.
- Rajasekar, S. (2010). *Computers in Education.* ND: Neelkamal Publications Pvt. Ltd.

Focus: This Course is focusing on skill development under the CO1, CO2, CO3, CO4 & CO5

Outcome:

After completion of this course the student teacher will able:

CO1: To explain the concept of ICT in education.
CO2: To develop skills in using Computer for Education.
CO3: To develop skills in using properties of Computer.
CO4: To develop skills in using MS Word applications for Education.
CO5: To develop skills in installing Software.

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

COs	POs/ PSOs
CO1	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3
CO2	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3
CO3	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3
CO4	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3
CO5	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3

SECOND SEMESTER

EDB 2001: Knowledge and Curriculum

Objective: *The course will enable the student teachers in dealing with various dimensions of knowledge and its transaction in a social environment and the basic concepts and process of curriculum planning, preparation of syllabi and development of text books at different levels.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Knowledge Basis of Education** 1.1. Basic concepts of Education: Teaching, Training, Learning, Skill, Beliefs and Education. 1.2. Contribution of Gandhi & Tagore in relation to child-centered education (activity, Discovery, Dialogue) 1.3. Concept, sources & types of Knowledge	20
UNIT II	**Curriculum Development** 2.1 Concept of Curriculum and Syllabus: Dimensions of Curriculum and their relationship with aims of education. 2.2 Curriculum at different levels- National, State and School. 2.3 Determinants of curriculum: Philosophical, Psychological, Sociological, Political, Culture and Economic. 2.4 Basic considerations in Curriculum Development	20
UNIT III	**Social Basis of Education** 4.1 Basic concepts of Society: Socialization, Equity and Equality, Modernity with reference to industrialization, democracy and individual Autonomy. 4.2 The role of culture, economy and historical forces in shaping the aims of education. 4.3 Individual opportunity, social justice and dignity in context of democratic education. 4.4 A study of Secularism, Nationalism and Universalism and their interrelationship with education.	20
UNIT IV	**Curriculum Practices** 4.1 Teachers' experiences and concerns: Laboratory work, Library and References, Field Survey, Group Discussion. 4.2 Nature of learner and learning process and subject matter. 4.3 Knowledge and ideology in relation to curriculum and text books. 4.4 National curriculum framework: Concept need and process of development.	20

Practicum/ Internal Works: (Any one)

- Socio-economic educational survey of nearby village/ urban settings.
- Role of education in empowerment of weaker sections of society.
- To analyze and prepare a report on the present curriculum of Board/ CBSE in the light of various determinates of curriculum development.
- To survey and prepare a project report on how far the present system of education is able to inculcate secularism, nationalism, and universalism.

Reference Books:

Butchvarov, P. (1970), The Concept of Knowledge, Evanston, Illinois: North Western University Press.
Chomsky, N (1986). Knowledge of Language, New York : Prager.
Cole Luella (1950). A History of Education: Socrates to Montessori, NewYork: Holt, Rinehart & Winston.
Datta, D.M. (1972). Six ways of Knowing. Calcultta.: Calcultta University Press,
Dewey, J (1997) Experience and Education, Touchstone, New York
Dewey, J (1956). The Child and the Curriculum and School and Society, University of Chicago Press, U.S.A. Chicago, Illinois.
Krishna M. J. (1947) On Education, New Delhi: Orient Longman.
Kumar K. (1996). Learning From Conflict, New Delhi: Orient Longman.
Margaret, K.T. (1999.) The open Classroom, Orient Longman: New Delhi: Hirst. Paul, Knowledge and curriculum.
Prema C. (2001). Teaching & Learning: The Culture of pedagogy, New Delhi: Sage Publication.

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3 & CO4

Outcome:

After the transaction of the course, student teachers will be able to:

CO1: To understand and explore the concept of education.
CO2: To develop understanding of philosophical, sociological and historical dimensions Of education
CO3: To analyze the philosophical reflections and educational thoughts of great Educational thinkers.
CO4: To Understand the nature of knowledge in Education and its contribution to status of Education as a discipline and interdisciplinary in nature.
CO5: To realize the need and importance of equity and equality in education.
CO6: To examine the concerns and issues related to curriculum.

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

COs	POs/ PSOs
CO1	PO1,PO2,PO8 /PSO1, PSO2,PSO4
CO2	PO1,PO2,PO8 /PSO1, PSO2,PSO4
CO3	PO1,PO2,PO5 /PSO1, PSO4
CO4	PO5,PO7,PO8 /PSO1, PSO4
CO5	PO7,PO8,PO9 /PSO1, PSO4
CO6	PO1,PO2 /PSO1, PSO4

EDB 2002: Learning and Teaching

Objective:

The course will enable the student teachers to understand about differential learning needs of the learners with regard to abilities, learning styles, socio-cultural differences, language, and learning difficulties.

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Understanding Learning** 1.1 Learning: Concept, Nature, types of learning & Factors influencing learning. 1.2 Learning strategies: Co-operative learning, peer-tutoring & collaborative & group learning; 1.3 Role of Teacher & School in relation to learning strategies. 1.4 Individual Differences: Concept, Types, Causes & Educational implications.	20
UNIT II	**Learning Paradigm** 2.1 Theories of Learning: – Connectionism theory (Trial & Error: Thorndike), concept, laws of learning & Educational Implications. – Conditioning theories: Classical conditioning (Pavlov) & Operant Conditioning (Skinner): Concept, characteristics and Educational Implications. – Social constructivist theory (Vygotsky & Bandura): Concept, nature & Educational Implications.	20
UNIT III	**Understanding Teaching** 3.1 Teaching: Concept, characteristic, features and levels of teaching. 3.2 Related concepts of Teaching (Training, conditioning, instruction & indoctrination) 3.3 Variables in the Teaching Process: The Learning task (Instructional Objectives), Learning Behaviour (Entry behaviours & Learner's characteristics) Teacher Behaviour: (Competence, Personality, Teaching Style). 3.4 Social-constructivist approach in teaching (Applications of Bruner, Ausubel & Vygotsky's ideas in teaching).	20
UNIT IV	**Phase & Models of Teaching** 4.1 Phase of Teaching: Pre-active, Interactive and Post-active. 4.2 Models of Teaching: Meaning, Need & Elements, Basic Teaching Model (Glaser), Concept Attainment Model (Bruner). 4.3 Teaching Strategies: Brain-Storming, Simulation, Role-playing, Gaming, Remedial teaching & Enrichment Programme.	20

Practicum/ Internal (Any one of the following)

- Observation report on Teaching-learning transaction process in School teaching practice.
- Seminar/ Presentation on learning theories.
- Application of teaching strategies (Brain-Storming, Simulation, Role-playing, Gaming, Remedial teaching) on any current/ social issue.

- Case-study on Individual differences.

Reference Books:

Chauhan, S.S. (2014). "*Innovations in Teaching Learning Process*", Noida: Vikas Publishing House Private Ltd.
Dececco, J.P. (1988) "*The Psychology of Learning and Instruction*", New Delhi: Prentice Hall.
Gagne, R.M. (1977). "*The conditions of learning*", New York, Chicago: Holt, Rinchart and Winston.
Joyce, B. & Weil, M. (1992). "*Models of Teaching*", New Delhi, Prentice Hall.
Kulkarni, S.S. (1986). "*Introduction to Educational Technology*", New Delhi: oxford & IBH Publishing Company.
Pandey, K.P.(1983). "*Dynamics of Teaching Behaviour*", Ghaziabad: Amitash Parkashan.
Pandey, K.P. (1980). "*A First Course in Instructional Technology*", Delhi: Amitash Parkashan.
Skinner, B.F.(1968). "*The Technology of teaching*", New York: Appleton Century Crofts.
Sharma, R.A. (1991). "*Technology of Teaching"*, Meerut: R. Lall Book Depot.
Sharma, S.K. (2005). "*Learning and Teaching: Learning process*", Delhi: Gyan Books Private Ltd.
Srivastava, D.S. and Kumari, S. (2005). "*Education: Understanding the learner*", Delhi: Gyan Books Private Ltd.
Walia, J.S. (2011). "*Technology of Teaching",* Jalandhar: Ahim Paul Publishers.
Walia, J.S. (2012). "*Teaching Learning Process*", Jalandhar: Ahim Paul Publishers.

Focus: This Course is employable under the CO1 to CO8.

Outcome:
After completion of this course the student teacher will able:

CO1: To understand the Concept of learning.
CO2: To explain the strategies and paradigms of learning.
CO3: To identify the individual differences among the learners.
CO4: To describe the educational implications of different theories of learning.
CO5: To understand the Concept of teaching.
CO6: To differentiate the relation with the modalities & variables in the teaching Process.
CO7: To describe the phases & models of teaching.
CO8: To understand the Strategies of Teaching.

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

COs	POs/ PSOs
CO1	PO1 /PSO1, PSO4
CO2	PO2,PO3 /PSO1, PSO4
CO3	PO2,PO7 /PSO1, PSO4

CO4	PO2,PO3,PO5,PO8 /PSO1, PSO3,PSO4
CO5	PO1 /PSO1, PSO4
CO6	PO2,PO3,PO5,PO8 /PSO1, PSO3,PSO4
CO7	PO1,PO3,PO6,PO8,PO10 /PSO1, PSO2,PSO3,PSO4
CO8	PO1,PO3,PO6,PO8,PO10 /PSO1, PSO2,PSO3,PSO4

EDB 2003: Pedagogy of Hindi

Objective *The course will enable the student teachers to understand the different roles of Hindi language, identify methods, approaches and materials for teaching Hindi at various levels in the Indian context.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**हिन्दी भाषा की प्रकृति महत्व, उद्देश्य एवं सिद्धान्त–** 1. हिन्दी भाषा का अर्थ एवं प्रकृति। 2. हिन्दी भाषा का महत्व मातृभाषा एवं राष्ट्रभाषा के रुप में 3. मातृभाषा एवं अन्य भाषा के रुप में हिन्दी शिक्षण के उद्देश्य कौशलात्मक उद्देश, ज्ञानात्मक उद्देश्य, सौन्दर्य बोधक उद्देश्य, रचनात्मक तथा अभिवृत्तसत्मक उद्देश्य। 4. हिन्दी भाषा शिक्षण के उद्देश्य (सामान्य एवं विशिष्ट) 5. हिन्दी भाषा शिक्षण के सामान्य सिद्धान्त।	32
UNIT II	**हिन्दी भाषा का पाठ्य क्रम–** क– 1.हिन्दी के विविध रुप 2.अन्तर्राष्ट्रीय स्तर पर हिन्दी 3.ज्ञान की भाषा के रुप में हिन्दी 4.राष्ट्रभाषा के रुप में हिन्दी 5.शिक्षक– शिक्षार्थी सम्बन्ध के पहलू के रुप में भाषा ख– पाठ्य–पुस्तक के गुण एवं उपयोगिता 1. पाठ्य–पुस्तक की विशेषताये 2. पाठ्य–पुस्तक का विश्लेषण एवं आलोचनात्मक मूल्यांकन ग– पाठ योजना एव शिक्षक सहायक सामग्री 1.पाठ योजना निर्माण के उपागम, इकाई योजना एवं उसकी उपयोगिता। 2.गद्य–पद्य कहानी, निबन्ध नाटक एवं व्याकरण की पाठ–योजना तैयार करना (पाठ्यक्रम के अनुसार)	32
UNIT III	**हिन्दी षिक्षण में विभिन्न विधायें एवं षिक्षण विधियों** 1. गद्य शिक्षण , पद्य शिक्षण एवं व्याकरण शिक्षण। 2. रचना शिक्षण (पत्र, निवन्ध, कहानी) 3. विभिन्न इकाई विधाओं पर पाठ–योजना निर्माण। 4. अनुवाद विधि, प्रत्यक्ष विधि आगमन–निगमन विधि, प्रयोजना विधि, पर्यवेक्षित विधि, निर्देशन विधि, स्वाध्याय विधि,अर्थ बोध विधि, प्रश्नोत्तर विधि, व्याख्या विधि, व्याख्यान विधि। 5. हिन्दी षिक्षण में मूल्यांकन–मूल्यांकन का अर्थ, स्वरुप एवं महत्व	32

प्रायोगिक कार्य –

1. आधुनिक कवि या साहित्यकार के व्यक्तित्व और कृतित्व पर आलेख तैयार करना।
2. पत्र–पत्रिकाओं में प्रकाशित रचनाओं अथवा नयी समकालीन साहित्य की पुस्तकों का अध्ययन, विश्लेषण और उनकी शैक्षणिक समस्यायें।
3. आस पास के क्षेत्र के किसी विशिष्ट समुदाय के लोगों का भाषा सर्वेक्षण और उनकी शब्दावली का अध्ययन करना।

Reference Books:

- पाण्डेय, आर0 एस0 (2008) हिन्दी शिक्षण, विनोद पुस्तक मन्दिर, आगरा–2
- नाथ, देवेन्द्र, राष्ट्रभाषा हिन्दी की समस्याऐं एवं समाधान।
- भाई, योगेन्द्र जीत, (2007) हिन्दी भाषा शिक्षण, विनोद पुस्तक मन्दिर, आगरा–2
- शर्मा, लक्ष्मीनारायन (2001) हिन्दी संरचना का अध्ययन–अध्यापन, केन्द्रीय हिन्दी संस्थान, आगरा
- शर्मा, लक्ष्मीनारायन (2004) भाषा की शिक्षण विधियॉ एवं पाठ नियोजन विनोद पुस्तक मन्दिर, आगरा–2
- ओड, एल0 के0 (1986) हिन्दी शिक्षण

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5 & CO6

Outcome:

इस पाठ्यक्रम के पूरा होने के बाद छात्र शिक्षक सक्षम होगा।

CO1: भाषा संरचना में हिन्दी भाषा तत्वों का ज्ञान प्रदान करना।

CO2: श्रवण, भाषण, वाचन एवं लेखन सम्बन्धी भाषायी कौशलों का ज्ञान।

CO3: इकाई, दैनिक व सूक्ष्म पाठ योजनाओं के महत्व से अवगत कराना है।

CO4: हिन्दी भाषा के वैज्ञानिक स्वरुपों कौशलों का ज्ञान कराना।

CO5: हिन्दी भाषा की विभिन्न विधाओं एवं उनके व्यवहारिक शिक्षण पाठ योजनाओं का ज्ञान कराना।

CO6: मातृ भाषा एवं राष्ट्रभाषा के रुप में हिन्दी की स्थिति से अवगत कराना।

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO5	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO6	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3

EDB 2004: Pedagogy of English

Objective: *The course will enable the student teachers to understand the different roles of English as second language, identify methods, approaches and materials for teaching English at various levels in the Indian context.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Place, Importance and Objectives of English as a Second Language: -** **1.1** Importance of English language: comprehension of English and mother tongue based learning. **1.2** Position of English: Pre & post-Independence in India. **1.3** Status of English in Indian school curriculum **1.3.1** Second language **1.3.2** First language **1.4** English language teaching: problems & issues **1.4.1** Library language **1.4.2** Window on the world **1.4.3** Medium of instruction **1.5** Aims and objectives teaching English at different levels.	32
UNIT II	**Methods, Approaches and Strategies:** **2.1** Grammar-cum-Translation method **2.2** Direct method, Audio- lingual and bilingual method **2.3** Structural approach and Communicative approach **2.4** Collaborative learning and Dramatization. **2.5** Strategies: Language games, Puzzles, role playing, concept mapping	32
UNIT III	**Developing Language Teaching Skills:** **3.1** Lesson planning: Concept, importance, preparation of Unit plan & Resource plan **3.2** Teaching Prose, Poetry, Story and Grammar. **3.3** Strategies of Teaching Skill: Listening, Reading, Speaking and Writing. **3.4** Supplementary skills: Reference Skill (e.g. using Dictionaries, Thesaurus, and Encyclopedias)	32

Practicum/Internal Work :(any one)

- List of structural items included in the text book at the secondary stage.
- Preparation of 5 word cards, 5 Picture cards and 5 puzzles.
- Enlist 50 innovative words with lexical interpretation.

Reference Books:

- Bansal, R.K. and Harrison, J.B. (1972), Spoken English for Indians, Madras : Orient Longman Ltd.
- Baruah, T.C. (1985), The English Teachers' Handbook, New Delhi: Sterling Publishing Pvt. Ltd.
- Bright and McGregor (2000), Teaching English as Second Language, Longman.
- Brumfit, C.J. (1984), Communicative Methodology in Language Teaching,

Cambridge: C.U.P.
- Collins cobuild English Grammar (2000), Harper Collins Publisher, India,
- Gimson A.C. (1980), An Introduction to the Pronunciation of English, London: Edward Arnold.
- Hornby, A.S. (1998), Guide to-Patterns and Usage in English O.U.P
- Lado, Robert (1971), Language Teaching, New Delhi, Tata McGraw Hill
- Publishing House Co. Ltd.
- Leech, Geofferey and Svartvik, Jan (2000), Communicative Grammar of English
- Cambridge C.U.P.
- Paliwal, A.K. (1998), English Language Teaching, Jaipur: Surbhi Publication.
- Palmer, H.L. (1964-65), The Principles of Language study, London: O.U.P.
- Quirk, Randolph and Greenbaum, (1973), A University Grammar of English,
- London.
- Richards J,C. and Rodgers.T.S. (1985), Approaches and Methods in Language
- Teaching, Cambridge C.U.P.
- Roach, Peter, (1991), English Phonetics and Phonology. Cambridge, C.U.P.
- Thomson, A.J. and Martinet (1998), A Practical English Grammar, ELBS, O.U.P.
- Venkateshwaran, S. (1995), Principles of Teaching English. Dehli: Vikas
- Publishing House Pvt. Ltd.
- Willis, Jane (1997), Teaching English Through English, O.U.P.

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5 & CO6

Outcome:

After completion of this course the student teacher will able:

CO1: To know about various basic application of grammar.
CO2: To explain the place of English language in India.
CO3: To describe English as a Second language in the multi -lingual country like India.
CO4: To explain different methods of teaching English.
CO5: To apply different teaching skills in the class room.
CO6: To develop lesson plan, micro lesson plan, TLM (Teaching Learning Materials) for teaching English as a second Language.

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO5	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO6	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3

EDB 2005: Pedagogy of Sanskrit

Objective: *The course will enable the student teachers to understand the different roles of Sanskrit language, identify methods, approaches and materials for teaching Sanskrit at various levels in the Indian context.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**संस्कृत भाषा की प्रकृति एवं महत्व।** 1. भाषा अर्थ, परिभाषाऐं, विकास एवं विशेषताऐं 2. भारतीय समाज में संस्कृत का महत्व और इसका प्राथमिक निम्न माध्यमिक स्तरों केपाठ्यक्रम में स्थान एवं त्रिभाषा सूत्र के अन्तर्गत संस्कृत। 3. संस्कृत शिक्षण के उद्देश्य संस्कृत के प्रमुख शिक्षण उद्देश्य। (सामान्य एवं विशिष्ट) 4. संस्कृत शिक्षण में कक्षा शिक्षण को सामान्य सिद्धान्त।	32
UNIT II	**संस्कृत भाषा का पाठ्यक्रम** 1 पाठ्यक्रम का अर्थ एवं निर्माण के सिद्धान्त 2 विविध स्तरों पर अध्ययन की विषयवस्तु 3 संस्कृत के वर्तमान पाठ्यक्रम का समालोचनात्मक मूल्यांकन और प्रगति हेतु सुझाव। 4 संस्कृत शिक्षण में श्रव्य–दृश्य सामग्री अर्थ, महत्व एवं प्रयोग। 5 संस्कृत शिक्षण अध्ययन में आने वाली कठिनाइयॉ एवं उनका समाधान।	32
UNIT III	**संस्कृत षिक्षण में विभिन्न विधायें एवं षिक्षण विधियां** 1 गद्य शिक्षण, काव्य शिक्षण, संस्कृत नाटक शिक्षण, संस्कृत व्याकरण शिक्षण,। 2 संस्कृत रचना शिक्षण, संस्कृत अनुवाद शिक्षण, । 3 विभिन्न इकाई विधाओं पर पाठ–योजना निर्माण, 4 संस्कृत भाषा की शिक्षण विधियां, – संभाषण विधि, अनुकरण विधि, प्रत्यक्ष विधि, अनुवाद विधि, चित्र वर्णन विधि, कहानी विधि, सुनो और बोलो विधि, अभ्यास विधि, संवाद विधि। 5 संस्कृत शिक्षण में मूल्यांकन– क– मूल्यांकन का अर्थ , स्वरुप एवं विशेषतायें	32

प्रायोगिक कार्य–

1. किसी एक संस्कृत कवि का विस्तृत परिचय देते हुये संस्कृत में किसी रचना पर आलेख तैयार करना।
2. अपने पड़ोस के 05 विद्यालयों का भ्रमण कर त्रिभाषा सूत्र की स्थिति की रिपार्ट तैयार करना।
3. किसी एक संस्कृत पत्रिका की समीक्षा।

Reference Books:

1. चतुर्वेदी, एस0 संस्कृत शिक्षण, नन्द पब्लिकेशन,
2. चौबे, बी0 एस0 (1985)संस्कृत शिक्षण, उ0 प्र0 हिन्दी संस्थान, लखनऊ
3. मित्तल, संन्तोष (2004)संस्कृत शिक्षण, आर0 लाल0 बुक डिपो, मेरठ
4. पाण्डेय, आ0 एस0 (1991)संस्कृत शिक्षण, विनोद पुस्तक मन्दिर, आगरा–2
5. गौतम, शैलजा एवं गौतम, रजनी (2006)संस्कृत शिक्षण, विनोद पुस्तक मन्दिर, आगरा–

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3 & CO4

Outcome:

अधिगम उपलब्धियाँ–

CO1: भाषा शिक्षण के आधारभूत सिद्धान्तों का विकास करना।
CO2: संस्कृत शिक्षण के उद्देश्यों का निर्धारण एव व्यवहारिक परिवर्तन हेतु प्रयास करना।
CO3: विभिन्न विधाओं के सफल अध्यापन हेतु विभिन्न विधियों का प्रयोग करना।
CO4: संस्कृत भाषायी दक्षता में होने वाली अशुद्धियों का कौशलानुसार निदान करना।

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3

EDB 2006: Pedagogy of Science

Objective: *The course will enable the student teachers to -gain insight on the meaning and nature of physical science for determining aims and strategies of teaching-learning.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Nature and Aims of Science** **1.1** Meaning, concept and nature of science. **1.2** Science as interdisciplinary area of learning i.e. facts, concepts principles, laws and theories. **1.3** General aims and objectives of teaching science at different stages of school of Education at primary, upper primary secondary, higher secondary. **1.4** Instructional objectives with special emphasis on Bloom's Taxonomy, statement of objectives in behavioral terms.	32
UNIT II	**Contents, Pedagogical Analysis and Methods** 2.1 Contents Analysis 2.1.1 Energy –type 2.1.2 Transmission of heat 2.1.3 Atomic Structure 2.1.4 Friction 2.1.5 Magnetism 2.2 Pedagogical Analysis of any of the above topics following points should be followed for pedagogical analysis: 2.2.1 Listing behavioral outcomes 2.2.2 Identification of minor an major concepts 2.2.3 Listing activities and experiments 2.2.4 Listing evaluation procedure 2.3 Methods 2.3.1 Method of teaching science and their classification. 2.3.2 Teacher centered methods-Lecture, Demonstration, and Experiment. 2.3.3 Pupil centered method-Problem-solving, Heuristic, Project method.	32
UNIT III	**Assessment and Evaluation in Science** 3.1 Evaluation in Science Teaching. 3.2 Types of tests: achievement and diagnostic test. 3.3 Continuous and comprehensive evaluation. 3.4 Science text book: Characteristics of a good text-book 3.5 Lesson plan, unit plan, and resource plan: meaning and definition 3.6 Approaches of lesson plan: Herbart's approach, Morison approach, RCEM approach	32

Practicum/Internal Work: (any one)

- Prepare pedagogical analysis of any one lesson from Science book.
- Prepare one diagnostic test for a secondary class
- Write the utility of continuous and comprehensive evaluation for students

Reference Books:

- Gupta, S.K. (1985). Teaching of Physical Science in Secondary Schools. New Delhi: Sterling Publications (Pvt.) Limited.
- Joshi, D. (2012).Methodology of Teaching Science. New Delhi: Dorling Kindersley (India) Pvt. Ltd.

- Mangal, S.K. (2009). Teaching of Physical Sciences. New Delhi: Arya Book Depot
- Pandey.(2003). Major Issues in Science Teaching. New Delhi: Sumit Publications.
- Radha, M.(2010). Teaching of Physical Science. New Delhi: Neelkamal Publishers.
- Rahi, A.S. (2012). Pedagogy in Physical Sciences and Teachers. U.S:Createspace Publications
- Sharma, R.C. (2006). Modern Science Teaching. New Delhi: Dhanpat Rai Publication.
- Sonika, R.(2012). Methodology of Teaching Science. New Delhi: Dorling Kindersley (India) Pvt. Ltd.
- Sood, J.K. (1992). New directions in Science Teaching. Chandigarh: Kohli Publishers.
- Vanaja, M. (2010). Educational Technology. New Delhi: Neelkamal Publishers

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5 & CO6

Outcome:

After completion of this course the student teacher will able:

CO1: To understand the nature and structure of science.

CO2: To understand the aims and objectives of teaching science at different level of school.

CO3: To apply principles of learning processes in teaching of Science.

CO4: To discuss a topic in Science effectively by adopting appropriate teaching strategy.

CO5: To identify specific learning difficulties in science and provide suitable remedial/individual instruction.

CO6: To use effectively the teaching aids in teaching science.

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO5	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO6	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3

EDB 2007: Pedagogy of Biology

Objective:

The course will enable the student teachers to develop insight about nature of biological sciences and for determining strategies of teaching-learning

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Nature, Aims & Objective** 1.1 Origin & nature of Biological Science 1.2 Values of Biological Sciences 1.3 Relation of Biology to other school subject 1.4 Difference between aims and objectives 1.5 General aims and objectives for different level of school teaching 1.6 Blooms taxonomy of educational objectives 1.7 Writing the objectives in terms of learning outcomes	32
UNIT II	**Method, Technique and Lesson Plan** 2.1 Different method and techniques of teaching Biology 2.2 Teacher centered methods-Lecture Method, Demonstration Method 2.3 Pupil centered method-Problem-solving method heuristic method, project method, assignment method, laboratory method & field trip 2.4 Importance of planning in teaching, preparing a lesson plan 2.5 preparation of unit plan and resource unit plan	32
UNIT III	**Curriculum and Evaluation** 3.1 Principles of curriculum development as applied to Biology Science. 3.2 Evaluation of existing Biology curriculum. 3.3 Importance and types of audio-visual aids, Improvised Teaching Aids. 3.4 Need, importance and evaluation of Biology text books. 3.5 Concept of measurement and evaluation, difference between measurement and evaluation.	32

Practicum/Internal Work: (any one)

- To construction and administration of an achievement test in Biology
- To give Pedagogical Analysis any one topic
- Develop working model for teaching Biology in any secondary class.

Reference Books:

- Aggarwal, D. D. (2008). Modern Method of Teaching Biology, Karanpaper Books. New Delhi.
- Anderson, R.D. (1992). Issues of Curriculum Reform in Science, Mathematics and Higher Order Thinking Across the Disciplines: The Curriculum U.S.A: University of Colorado.
- Bremmer, J. (1967). Teaching Biology, Macmillan, London.
- Buffaloe, N. and Throneberry, J.B. (1972). Principles of Biology University Press, New Delhi: Prentice- Hall of India Ltd.
- Carin. &Robert, S. (1989). Teaching Modern Science (5th edition). U.S.A: Merill Publishing Co.
- Green, T.L. (1965). The Teaching of Biology in Tropical Secondary Schools, London:

Oxford University Press.
- Gupta, S.K. (1985).Teaching of Physical Science in Secondary Schools. New Delhi, Sterling Publishing (Pvt. Ltd).
- Heiss. E.D., Obourn. S., & Hoffman. C.W. (1985) Modern Science Teaching. New Delhi: Sterling Publishing (Pvt) Ltd. Macmillian Company Press.
- Heiss, Obourn.,& Hoffman. (1985) Modern Science in Secondary Schools. New Delhi: Sterling Publishing Private Ltd.
- Nayak, (2003). Teaching of Physics. New Delhi: APH Publications.
- Pandey,(2003). Major Issues in Science Teaching. New Delhi: Sumit Publications.
- Passi, B.K. (1976). Becoming a Better Teacher: Micro Teaching Approach, Ahemedabad: Sahitya Mudranalaya.
- Patton, M.Q. (1980).Qualitative Evaluation Methods. New Delhi: Sage Publications.
- Sharma, R.C. (2006). Modern Science Teaching .New Delhi: Dhanpat Rai Publications.
- Siddifit, S. (1985). Teaching of Science Today and Tomorrow. New Delhi: Doba's House.
- Yadav, M.S. (2003) Teaching of Science. New Delhi: Anmol Publications

Focus: This Course is focusing on employability and skill development under the CO1, CO2 & CO3

Outcome:

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

CO1: To develop awareness about developments in the area of biological sciences.

CO2: To orient prospective teachers in specific educational aspects of science e.g. aims and objective of biological science, pedagogical analysis of contents in biological sciences, methods of teaching, evaluation.

CO3: To enable prospective teachers to be effective teachers in order to perform the required role as a biological teacher under Indian School conditions

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3

EDB 2008: Pedagogy of Mathematics

Objective: *The course will enable the student teachers to develop insight into the meaning, nature, scope and objective of mathematics education and competencies for teaching-learning of mathematics through various measures.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Concept, Meaning and Objectives of Mathematics** **1.1** Concept, meaning and nature of mathematics. **1.2** History of mathematics. **1.3** Contribution of Indians and western mathematics. **1.4** Aims and objectives of teaching mathematics. **1.5** Blooms Taxonomy relating to the teaching objectives in mathematics (cognitive, Affective, psychomotor domain)	32
UNIT II	**Methods, Techniques and Aids of Teaching Mathematics** **2.1** Methods of teaching Mathematics: Modified form of lecture (lecture-cum-demonstration, Inductive- **2.2** Deductive, Analytic-synthetic, Problem-solving, Laboratory, Project) **2.3** Techniques of teaching Mathematics: Oral, Written, Drill, Self-study **2.4** Audio-visual Aids in Mathematics teaching: Importance, principles of selection, types and uses **2.4** Mathematics club, workshop and seminars.	32
UNIT III	**Planning of Teaching and Evaluation** **3.1** Lesson planning- concept, importance, preparation **3.2** Unit plan– concept, importance and preparation **3.3** Construction of unit tests: Design and Blue print. **3.4** Concept, need, importance & process of Evaluation **3.5** Functions and characteristics of good Evaluation	32

Practicum/Internal Work: (any one)

- Improvising Low cost teaching aids in mathematics.
- Preparation of a unit plan in Mathematics.
- Prepare one working model for teaching maths in primary/secondary class.

Reference Books:

- Kumar S., Ratnalikar D. N. (2003), Teaching of mathematics, Anmol Publications Pvt. Ltd. New Delhi.
- Mustafa M. (2004), Teaching of mathematics, New trends and innovations, Deep and Deep Publications Pvt. Ltd., New Delhi.
- Wadhwa S., (2000), Modern methods of teaching mathematics, Sarup and sons, New Delhi.
- Yadav S. (2007), Teaching of mathematics, Vinod Pustak Mandir, Agra.
- जैन, एस. एल. (2007), गणित शिक्षण, राजस्थान हिन्दी ग्रन्थ अकादमी, जयपुर
- नेगी जे. एस. (2006), गणित शिक्षण, विनोद पुस्तक मंदिर, आगरा

- रावत एम. एस. (1960), अग्रवाल एम. बी. एल., गणित शिक्षण, विनोद पुस्तक मंदिर, आगरा
- सिंह एस. (2005), गणित शिक्षण, विनोद पुस्तक मंदिर, आगरा

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5 & CO6

Outcome:

After completion of this course the student teacher will able :

CO1: To understand and appreciate the uses and Significance of Mathematics in daily life.
CO2: To learn successfully various approaches of teaching mathematics and use them judiciously.
CO3: To know the methods of planning instruction for the classroom.
CO4: To prepare curricular activities and organize the mathematics Laboratory.
CO5: To appreciate and organize activities to develop aesthetics of mathematics.
CO6: To give competence in teaching different mathematics topic effectively

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO5	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO6	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3

EDB 2009: Pedagogy of Social Science – I (History, Civics)

Objective: *The course will enable the student teachers to understand key concepts of the various social sciences as well as related pedagogical issues.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Concept, Objectives & Values** 1.1 Meaning, Scope, importance and values of teaching Social-Science. 1.2 Aims and objectives of teaching of Social Studies with Special reference to present Indian School. (Primary, Secondary-Senior Secondary). 1.3 Bloom's taxonomy of objectives. 1.4 Writing objectives in behavioral terms with particular reference to teaching of History /civics. 1.5 Role of Social Science teacher.	32
UNIT II	**Methods and Techniques of Teaching Social-Studies** **2.1** Methods of teaching Social Studies: lecture method, observation method, socialized recitation method, Demonstration and discussion, project Method. **2.2** Techniques of teaching-questioning, Excursion, Narration, review and role playing. **2.3** Preparation and presentation of lesson plan. **2.4** Development of self-instructional material bulletin Board, Maps, Scrap book, computerized materials.	32
UNIT III	**Development/Utilization of Instructional Aids** **2.1** Charts, Models, Maps, Film sticks, Graphs, T.V., Computer **2.2** Meaning Importance and Objectives of Evaluation Devices: Oral Test, Written Test, Practical Test, Blue Print of a Question Paper, Observation, Diagnostic	32

Practicum/Internal Work: (Any one)

- Studying historical monuments available locally and writing a report on it.
- Prepare a scrap book on any social issue.
- Studying any social problem and write a report of the same.

Reference Books:

- Agrawal, J.C., Teaching Social Studies, Vikas Publishing House, Put. Ltd., Delhi, 1989.
- Bining, A.C. and Brining, D.H., Teaching the Social study in Secondary School, Mc Graw Hill Company, New York, 1952
- Bhattacharya and Daqi, D.R.., Teaching of Social Study in Indian School, Acharya Book Depot, Baroda, 1966.
- Ellis, Arthur K, Teaching and Learning Elementary Social studies, Alloy and Bacon, Boston 1991

•Kaushik, Vijay kumar, Teaching of Social Studies in Elementary School, Anmol Publication, New Delhi.
•Kochher, S.K., Teaching of Social Studies, Sterling Publisher Pvt. Ltd. New Delhi, 1999.
•Wesley, E.B. & Wronski, S.P. Teaching of Social Studies in High School, D.C. Health and Company Bostan, 1958
•Yagni, K.S., Teaching of Social Studies in India, Orient Longman, Bombay, 1996
•प्रसाद, भुवनेश्वर, समाज अध्ययन का शिक्षण, ज्ञानपीठ प्रा. लिमिटेड, पटना – 1992
•सिंह रामपाल, सामाजिक अध्ययन का शिक्षण, लक्ष्मी नारायण अग्रवाल, आगरा, 1998

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5, CO6, CO7 & CO8

Outcome:

After completion of this course the student teacher will able:

CO1: To enable the student teacher to appreciate the need for learning social science.
CO2: To help them to understand the place of social science in the secondary school curriculum.
CO3: To develop the skills in student-teachers to select and apply appropriate methods and evaluate social science.
CO4: To enable the student-teacher to critically examine the social-science syllabus and text books.
CO5: To develop the classroom skills needed for teaching of Social-science.
CO6: To develop the ability to organize co-curriculum activity and utilize community resources for promoting Social-science learning.
CO7: To acquire the ability to develop instructional support materials.
CO8: To review the text-book of Social-science (secondary level).

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO5	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO6	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO7	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO8	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4

EDB 2010: Pedagogy of Social Science – II (Economics, Geography)

Objective: *The course will enable the student teachers to understand key concepts of the various social sciences as well as related pedagogical issues.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Concept, Objectives & Values** 1.1 Meaning, Scope, importance and values of teaching Social-Science. 1.2 Aims and objectives of teaching of Social Studies with Special reference to present Indian School. (Primary, Secondary-Senior Secondary). 1.3 Bloom's taxonomy of objectives. 1.4 Writing objectives in behavioral terms with particular reference to teaching of History /civics. 1.5 Role of Social Science teacher.	32
UNIT II	**Methods and Techniques of Teaching Social-Studies** 2.1 Methods of teaching Social Studies: lecture method, observation method, socialized recitation method, Demonstration and discussion, project Method. 2.2 Techniques of teaching-questioning, Excursion, Narration, review and role playing. 2.3 Preparation and presentation of lesson plan. 2.4 Development of self-instructional material bulletin Board, Maps, Scrap book, computerized materials.	32
UNIT III	**Development/Utilization of Instructional Aids** 2.1 Charts, Models, Maps, Film sticks, Graphs, T.V., Computer 2.2 Meaning Importance and Objectives of Evaluation Devices: Oral Test, Written Test, Practical Test, Blue Print of a Question Paper, Observation, Diagnostic	32

Practicum/Internal Work: (Any one)

- Studying historical monuments available locally and writing a report on it.
- Prepare a scrap book on any Economical issue.
- Studying any Geographical problem and write a report of the same.

Reference Books:

- Agrawal, J.C., Teaching Social Studies, Vikas Publishing House, Put. Ltd., Delhi, 1989.
- Bining, A.C. and Brining, D.H., Teaching the Social study in Secondary School, Mc Graw Hill Company, New York, 1952
- Bhattacharya and Daqi, D.R.., Teaching of Social Study in Indian School, Acharya Book Depot, Baroda, 1966.
- Ellis, Arthur K, Teaching and Learning Elementary Social studies, Alloy and Bacon, Boston 1991

•Kaushik, Vijay kumar, Teaching of Social Studies in Elementary School, Anmol Publication, New Delhi.
•Kochher, S.K., Teaching of Social Studies, Sterling Publisher Pvt. Ltd. New Delhi, 1999.
•Wesley, E.B. & Wronski, S.P. Teaching of Social Studies in High School, D.C. Health and Company Bostan, 1958
•Yagni, K.S., Teaching of Social Studies in India, Orient Longman, Bombay, 1996
•प्रसाद, भुवनेश्वर, समाज अध्ययन का शिक्षण, ज्ञानपीठ प्रा. लिमिटेड, पटना – 1992
•सिंह रामपाल, सामाजिक अध्ययन का शिक्षण, लक्ष्मी नारायण अग्रवाल, आगरा, 1998

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5, CO6, CO7 & CO8

Outcome:

After completion of this course the student teacher will able:

CO1: To enable the student teacher to appreciate the need for learning social science.
CO2: To help them to understand the place of social science in the secondary school curriculum.
CO3: To develop the skills in student-teachers to select and apply appropriate methods and evaluate social science.
CO4: To enable the student-teacher to critically examine the social-science syllabus and text books.
CO5: To develop the classroom skills needed for teaching of Social-science.
CO6: To develop the ability to organize co-curriculum activity and utilize community resources for promoting Social-science learning.
CO7: To acquire the ability to develop instructional support materials.
CO8: To review the text-book of Social-science (secondary level).

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO5	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO6	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO7	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO8	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4

EDB 2011: Pedagogy of Commerce

Objective: *: The course will enable the student teachers to understand key concepts of the commerce as well as related pedagogical issues.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Conceptual Framework of Commerce** 1.1 Meaning, Nature and scope of Commerce. 1.2 Need and significance of teaching commerce at secondary level. 1.3 General aims and objectives of teaching Commerce. 1.4 Objectives of Teaching Commerce according to Bloom's Taxonomy of Educational objectives. 1.5 Correlation of commerce with Economics, Mathematics, Geography, Social Science 1.6 Importance of commerce in daily life.	32
UNIT II	**Approaches and Methods of Teaching Commerce and Lesson Planning** 2.1 Lecturer Method 2.2 Discussion Method 2.3 Project Method 2.4 Problem solving Method 2.5 Techniques of commerce teaching-questioning and demonstration. 2.6 Approaches of book-keeping teaching (journal approach, ledger approach, cash-book & equation approach) 2.7 Plans of commercial practice teaching (rotation, office model, battery and co-operative plan). 2.8 Teaching aids in commerce. 2.9 Co-curricular activities in commerce.	32
UNIT III	**Evaluation in Commerce** 3.1 Concept, scope and importance of evaluation. 3.2 Tools and techniques of evaluation and characteristics of a good test. 3.3 Formative and summative evaluation. 3.4 Continuous and comprehensive evaluation (CCE) 3.5 Construction and administration of an achievement test. 3.6 Diagnostic testing and remedial teaching. Techniques of evaluation and characteristics of a good test	32

Practicum/internal Work: (any one)

- Visit to banks/insurance house/ trade centers/companies/other business house and prepare a report.
- Develop a Multi-Media lesson using appropriate ICT resources and transacting the same before peers in simulated teaching exercise.
- Organize a co-curricular activity related to commerce for strengthening the knowledge of any topic taught recently in the class.

Reference Books:

- Singh, R.P. & Singh, and P.: Vanijya Shikshan, Agra: Vinod Pustak Mandir.
- Tripathi, S.: Teaching Methods, New Delhi: Radha Publications.

- Chauhan, S.S.: Innovations in Teaching Learning Process, New Delhi: Vikas Publication House.
- Siddiqui, M.H.: Excellence of Teaching, Asia Publication House, New Delhi
- Rao, S.: Teaching of Commerce, New Delhi: Anmol Publications.
- Tyagi, G.D.: Vanijya Shikshan, Agra, Agarwal Publications.
- Singh,Y.K: Teaching of Commerce, New Delhi: A.P.H. Publishing House

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5 & CO6

Outcome:

After completion of this course the student teacher will able:

CO1: To help the student to acquire the basic understanding in the field of commerce education.
CO2: To develop the ability to plan curriculum and instructions in commerce at school level.
CO3: To develop the ability to critically evaluate existing school syllabus and text book.
CO4: To impart knowledge about the methods and devices of teaching commerce and to develop the skill of using the same.
CO5: To develop the ability of preparing an achievement test.
CO6: To develop commercial efficiency among students.

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO5	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3
CO6	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3

EDB 2012: Pedagogy of Home Science

Objective: *The course will enable the student teachers to understand* the meaning and scope of Home Science and various techniques and approaches of Teaching of Home Science at Higher Secondary level.

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Meaning and Methods of Teaching Home Science** 1.1 The modern meaning of home science and its place in secondary school 1.2 Objectives of teaching home science at senior secondary level. 1.3 Status of home science 1.4 Scope of home science in school curriculum 1.5 Methods of teaching home science-Discussion method, Demonstration method, Project method, Problem solving method, Field trips, Assignment method, Exhibition and displays	32
UNIT II	**Planning and Designing for Effective Instruction in Home Science** 2.1 Planning for instructional process, Need, advantages and strategies. 2.2 Lesson Planning –design, approaches & writing lesson plan. 2.3 Audio visual aids in teaching of Home Science. 2.4 Principles of Curriculum planning and development of Home Science Syllabus. 2.5 Characteristics of a good Home Science text book. 2.6 Use and management of Home Science Laboratory.	32
UNIT III	**Correlation of Home Science with other Subjects and Evaluation in Home Science** 3.1 Correlation of Home Science with other subjects and School activities. 3.2 SUPW related to Home Science. 3.3 Teaching of Human Development 3.4 Teaching of Foods and Nutrition. 3.5 Teaching of Textiles and Clothing. 3.6 Teaching Community Resource Management and Extension. 3.7 Evaluation and assessment 3.8 Techniques for assessment in theory and practical	32

Practicum / Internal Work: (any one)

- Flower arrangement.
- Visit to an industry related to food processing/ home decoration and report writing.
- Prepare nutrition chart.

Reference Books:

- Bloom, Benjamin, (Ed.) and others (1965) Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook 1: Cognitive Domain, New York,David McKay Company Inc.
- Broudy, Harry S. and Palmer, John R. (1966) Examples of Teaching Method, Chicago, Second Printing, Chicago, Rand McNally & Co.
- Chandra A. (1995) Fundamentals of Teaching Home Science, ND: Sterling publishers.
  Dale Edgar (1962), Audio Visual Methods in Teaching, revised edition, Hold, Rivehart and Winston, New York.
- Das,R.R. & Ray B. (1989) Teaching of Home Science, ND: Sterling Publishers.
- Devdas R.P.(1976). Teaching Home Science, AI Council for Teaching Science.

- Hall & Paolucci (1968), Teaching Home Economics, NY: Wiley Eastern P. Ltd.

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5 & CO6

Outcome:

After completion of this course the student teacher will able:

CO1: To familiarize themselves with the meaning and scope of Home Science and objectives of Teaching home science at Higher Secondary Level.

CO2: To understand the importance of Teaching Home Science in Schools.

CO3: To know and apply various techniques and approaches of Teaching of Home Science at Higher Secondary level.

CO4: To plan instructions effectively for Teaching of Home Science.

CO5: To evaluate student performance effectively with reliability and validity.

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO5	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4

EDB 2080: Reading & Reflecting Text

Objective: *The course will enable the student teachers to develop proficiency in reading and responding to written texts, examine and appreciate authentic literary and non-literary texts and develop study and reference skill.*

Credits: 02 **L-T-P-J: 0-0-2-0**

Module No./Unit	Content	Teaching Hours
UNIT I	• Read an Educational journal Article and summarize in your own words. (100-150 words). • Read a chapter from a Educational Book and summarize in your own words. (100-150 words). • Give Review on any one Educationist's Autobiography. (100-150 words). • Give Review on any one Educationist's Biography. (100-150 words). • Preparing a Vocabulary Book (50 words), with Meanings and Usage. • Write a review on National Curriculum frame work-2009. (100-150 words). • Write a review on RTE Act, 2009. (100-150 words). • Write a review on Policy document. (100-150 words). • Give Review on a Historical book or a Mythological book. (100-150 words). • Give book review with critical analysis of Content and Language of the text. (Any two from following). (100-150 words). • Wings of Fire A.P.J. Abdul Kalam (अग्नि की उड़ान) • Swami Vivekananda autobiography (विवेकानन्द की आत्मकथा) • The Story of My Experiments with Truth. (Gandhi Ji) • Malgudi Days short story (R. K. Narayan) • Swami Vivekananda Turning Points (हिन्दी)	64

Reference Books:

- Agnihotri, R.K. and Vandhopadhyay, P.K. (ed.) (2000). Bhasha, bhubhashita or Hindi: Ekanthsamvaad, New Delhi: Shilalekh.
- Anderson R.C. (1984). Role of the Reader's Schema in comprehension, learning and memory. In R.C Anderson, J. Osborn, & R. J. Tierney (Eds.), Learning to read in American Schools: Basal readers and content texts. Psychology Press.
- Butler, A. and Turbill, J. (1984). Towards Reading-Writing Classroom. New York: Primary English Teaching Association Cornell University.
- Grellet, F. (1981). Developing Reading skills: A practical guide to reading comprehension exercise Cambridge University Press.
- Mason, J. M. and Sinha, S. (1992). Emerging Literacy in the Early Childhood Years. Applying a Vygotskian Model of Learning and Development in B. Spodek (Ed.) Handbook of Research on the Education of Young Children, New York: Macmillan.137-150.
- NCERT (2005). National Curriculum Framework (NCF). New Delhi: NCERT.
- Reading Development Cell, NCERT (2008).Reading for meaning. New Delhi: NCERT. Rosenblatt, Louise M. (1980). What Fact Does This Poem Teach? Language Arts.57(4).Tompkims, Gail E. (1994). Teaching Writing: Balancing Process and Product. Macmillan.
- California Yule, G. (2006).The study of language. Delhi: Cambridge University Press.
- Martin, Jr. B. (1987). The Making of a Reader: A Personal Narrative. In Bernice E. Cullinan, Children's Literature in the Reading Programme. Michigan: International Reading Association.

- Richards, J.C. and Theodore S. R. (1986). Approaches and Methods in Language Teaching: A description and Analysis. India: Cambridge University Press.

Focus: This Course is focusing on skill development under the CO1, CO2, CO3, CO4, CO5, CO6, CO7,CO8 & CO9

Outcome:

After completion of this course the student teacher will able:

CO1: To read and respond to variety of texts in different ways, may be personal, creative or Critical.
CO2: To enhance their capabilities as readers and writers by becoming participants in the process of reading
CO3: To get involved in the reading interactively – individually and in groups become resources for one another
CO4: To comprehend and think reflectively on spoken or written texts
CO5: To read critically and analyze course readings, ideas presented in the class and experiences in schools
CO6: To write with a sense of purpose and for an audience
CO7: To learn to think together and develop meta-cognitive awareness to become conscious of their own thinking process
CO8: To develop study habits of reading and writing.
CO9: To develop skill of summarization and note-making.

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

COs	POs/ PSOs
CO1	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO2	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO3	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO4	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO5	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO6	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO7	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO8	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4
CO9	PO1,PO3,PO6,PO10 /PSO1, PSO2, PSO3,PSO4

EDB 2081: Scouting & Guiding

This is international programme to development social-sensitivity and to students and to make students dutiful towards the nation & the world so that may serve humanity.

Objective:

- To develop the characteristics of good citizenship.
- To develop world Peace.
- To develop two feeling of dignity of labour.
- To make Students self-reliant.
- To develop the physical, mental & spiritual powers.

Credits: 02 **L-T-P-J: 0-0-2-0**

Module No./Unit	Content	Teaching Hours
UNIT	**(Practicum Activities)** This can be achieved though organizing a scouting camp of 6-7 days to impart training in- • First-aid against fracture, snake bite poison, electric current etc. • Using safety-measures against fire. Chemicals, electrical equipment, etc. • Using compass & maps. • Using deferent types of knots. • Constructing a bridge, etc. • Different types of physical exercise etc.	64

Reference Books:

Focus: This Course is focusing on skill development under the CO1, CO2, CO3, CO4 & CO5

Outcome:

After completion of this course the student teacher will able:

CO1: To develop the characteristics of good citizenship.
CO2: To develop world Peace.
CO3: To develop two feeling of dignity of labour.
CO4: To make Students self-reliant.
CO5: To develop the physical, mental & spiritual powers.

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

COs	POs/ PSOs
CO1	PO5,PO7,PO8,PO9,PO10 /PSO1, PSO4
CO2	PO5,PO7,PO8,PO9,PO10 /PSO1, PSO4
CO3	PO5,PO7,PO8,PO9,PO10 /PSO1, PSO4
CO4	PO5,PO7,PO8,PO9,PO10 /PSO1, PSO4
CO5	PO5,PO7,PO8,PO9,PO10 /PSO1, PSO4

EDB 2082: Understanding ICT and Its Application-II

Objective: *The present course focuses on moving beyond computer literacy and ICT-aided learning, to help student-teachers interpret and adapt ICTs in line with educational aims and principles. It explores ICTs along three board strands; teaching-learning, administrative and academic support systems, and broader implications for society. The course will help student-teachers reflect critically and act responsibly to prevent use of ICTs to support centralization of larger knowledge structures; it will show student-teachers how ICTs can be adapted to support decentralized structures and processes; as well as build the 'digital public' to make education a participatory and emancipatory process.*

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

Module No./Unit	Content	Teaching Hours
	MS-Excel & MS-Power Point • MS-Excel -Concepts of Workbook • MS-Excel - Concepts of Worksheets • MS-Excel - Various Data Types • MS-Excel - Using different features with data-Cell and Texts, Inserting, Removing • MS-Excel -Resizing of Columns & Rows • MS-Excel -Working with Data and Ranges • MS-Excel -Entering data into worksheet, • MS-Excel - Heading information, data, text, dates, alphanumeric, values • MS-Excel –Saving & Quitting worksheet • MS-Excel -Opening and moving around in an existing worksheet • MS-Excel -Toolbars and menu • MS-Excel - keyboard shortcuts • MS-Excel –Coping • MS-Excel –Renaming • MS-Excel – moving • MS-Excel - adding and deleting • MS-Excel - coping entries and moving between workbooks • MS-Excel - Different Views of Worksheets-Column Freezing, Labels • MS-Excel - Different Views of Worksheets-Hiding, Splitting etc., • MS-Excel -Using different features with Data and Text • MS-Excel - Use of Formulas- Calculations and Functions • MS-Excel -Cell Formatting including Borders & Shading • MS-Excel -Working with Different Chart Types • MS-Excel -Printing of Working with various options. • MS-Excel - Printing of Worksheets with various options. • MS-Power Point -Creating new presentations • MS-Power Point - working with Presentation • MS-Power Point -Using Templates and Wizards • MS-Power Point - Slides & it's different views • MS-Power Point –Inserting • MS-Power Point -Deleting • MS-Power Point -Copying of Slides • MS-Power Point - Working with Notes, • MS-Power Point – Working with Handouts • MS-Power Point - Working with Columns and Lists • MS-Power Point -Adding Graphics • MS-Power Point –Animation • MS-Power Point -Sound and Movies to a Slide • MS-Power Point -PowerPoint Designing • MS-Power Point -Presentation of a Slide Show • MS-Power Point -Printing Presentations, Notes, and Handouts with print options.	96

Reference Books:

- Cox, J. & Urban, P. (1999). Quick Courses in Microsoft Office, New Delhi: Galgotia Publications.
- Jain, Satish. (1990). Introduction to Computer Science and Basic Programming, New Delhi: Prentice Hall of India.
- Saxena, S. (1998). A first Course in Computer, New Delhi: Vikas Publications.
- Sinha, P.K. (1990). Computer Fundamentals, New Delhi: BPB Publications.
- Tanenbaum, A.S. (1998). Computer Networks, New Delhi: Prentice-Hall of India.
- Intel (2003). Intel Innovation in Education, New Delhi: Student Work Book.
- Rajasekar, S. (2010). *Computers in Education.* ND: Neelkamal Publications Pvt. Ltd.

Focus: This Course is focusing on skill development under the CO1, CO2, CO3, CO4, CO5, CO6 and CO7

Outcome:

After completion of this course the student teacher will able:

CO1: To explain the concept of ICT in education.
CO2: To develop skills in using MS Excel applications for Education.
CO3: To perform simple arithmetic calculations directly in a cell as well as by referring to another cell.
CO4: To develop skills in using MS Power Point applications for Education.
CO5: To Develop Skills in Insert clipart images and shapes to slides.
CO6: To use internet efficiently to access information and communicate with others.
CO7: To understand the applications of E-learning in Education.

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

COs	POs/ PSOs
CO1	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3
CO2	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3
CO3	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3
CO4	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3
CO5	PO1,PO4,PO6,PO8, /PSO1, PSO2,PSO3

EDB 2083: Yoga Education

Objective: *The course will enable the student teachers to create interest for the practice of Yogasanas, meditations and understand the process of stress management through Yoga education.*

Credits: 02 **L-T-P-J: 0-0-2-0**

Module No./Unit	Content	Teaching Hours
UNIT I	**1. Concept of Yoga Ashtang yog:** 1.1 Yoga meaning concept and importance. 1.2 Mis-concept of yog. 1.3 Precautions to keep in mind while performing Yogasan. 1.4 Different types of Yogasans & their techniques of practicing.	32
UNIT II	**2. Miditation, Pranayam and stress Management.** 2.1 Pranayam: meaning, nature and relationship with mind. 2.2 Different types of Pranayam. Kapalbhrika Pranayam, Surya Bhedan Pranayam, Chandrabhedan Pranayam, Anulomvilom Pranayam. 2.3 Meditation: nature, procedure and importance. 2.4 Stress: meaning, reasons, role of Yog in stress management.	32

Practicum/ Internal Work: (any one)

- Yagasan, Pranayam, and Shudhi kriya organized at School level.
- Critical analysis of any theme of the course content in about eight to ten pages.

Reference Books:

Focus: This Course is focusing on skill development under the CO1, CO2 & CO3

Outcomes:

After completion of this course the student teacher will able:

CO1: Introduce the student teacher to the philosophical bases of Yoga.

CO2: Understand the process of stress management through Yoga education.

CO3: Acquire the knowledge of techniques of performing Yogasan and develop the skill for the same.

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

COs	POs/ PSOs
CO1	PO9,PO10 /PSO1, PSO4
CO2	PO9,PO10 /PSO1, PSO4
CO3	PO9,PO10 /PSO1, PSO4

THIRD SEMESTER

EDB 3080: School Internship

Objective: *The field experience helps in expanding the competencies and skills which are essential for a teacher to serve as a facilitator of learning. During internship student teachers interact with the teachers, students, administrators and community including parents and try to understand the problems of schools and students which helps in their development as a teacher. They are also provided with opportunities to participate and organize various programmes and activities which schools generally organize to facilitate students' learning and development.*

Credits: 18 **L-T-P-J: 0-0-16-0**

Module No./Unit	Content	Credits
Pre-Internship	Micro Teaching/Skill orientation (One week)	5
	Simulation Teaching (One week)	
	Action Research-Theory	
	Psychological Test-Theory	
	Achievement Test-Theory	
School-Internship	**Classroom Observation and Interaction with school Teachers, children and community & Observation Report of School** Description and evaluation of school with special reference to geographical, socio-cultural environment, physical infrastructure, human resource, philosophy, aims, organization and management.	5
	Teaching of selected pedagogy subjects in classes with constructivist approach by student teacher/intern (Thirty in each pedagogy subject total 60 including criticism lesson plan)	
	Peer –Observation (10 in each subject) **Participation in co-scholastic work of school with report making-** 1.Organizing morning Assembly 2.Preparation of time-table of the class 3.Maintaining student's attendance and preparing a monthly record of student's attendance. 4.Planning and participation in community awareness programme with school children (Rallies, Awareness campaign and cleanliness campaign), Or Planning and participation in games and sports programme during school internship, Or Planning and participation in literary & cultural activities- Drama/Art/Debate/quiz/science fair, exhibition, science club, nature study.	
	Preparation, Orientation and use of Teaching Learning material (TLM) in each teaching subjects.	
	Preparation of a Question Papers/ Achievement Test (One in each teaching subject).	
	Action research project/report on at least one problem area of schooling.	
	Psychological Test on school children-any five	
	Maintenance of a reflective diary or journal to record day to day happenings in school hours and reflections thereon.	
	Preparation and Teaching two ICT/multimedia based lesson plans in each	
	External Viva-voce	3
	Final Lesson of two pedagogy of school subjects (Written Lesson – Marks 10 **Presentation – Marks 20** **Teacher Traits – Marks 10** **Teaching Aids - Marks 10)**	5
	Total	18

Focus: This Course is focusing on employability, entrepreneurship and skill development under the CO1, CO2, CO3, CO4, CO5, CO6 and CO7

Outcome:

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

CO1: Develop a broad repertoire of perspectives, professional capacities, teacher dispositions, sensibilities and skills.
CO2: Experience and understand the real world of teaching with the help of systematic supervisory support and feedback.
CO3: Develop understanding about teaching, pedagogy, school management and community involvement

CO4: Build skills and abilities of communication, reflection, art, aesthetics, theatre and self-expression.

CO5: To improve knowledge, skill, social and moral values

CO6: To provide access and training to the disadvantaged by practicing special tutorial system.
CO7: Development of competencies and skills needed for becoming effective teachers in the new scenario

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

COs	POs/ PSOs
CO1	PO1,PO2,PO3,PO4,PO5,PO6,PO8,PO10 /PSO1, PSO2,PSO3,PSO4
CO2	PO1,PO2,PO3,PO4,PO5,PO6,PO8,PO10 /PSO1, PSO2,PSO3,PSO4
CO3	PO1,PO2,PO3,PO4,PO5,PO6,PO8,PO10 /PSO1, PSO2,PSO3,PSO4
CO4	PO1,PO2,PO3,PO4,PO5,PO6,PO8,PO10 /PSO1, PSO2,PSO3,PSO4
CO5	PO1,PO2,PO3,PO4,PO5,PO6,PO8,PO10 /PSO1, PSO2,PSO3,PSO4
CO6	PO1,PO2,PO3,PO4,PO5,PO6,PO8,PO10 /PSO1, PSO2,PSO3,PSO4
CO7	PO1,PO2,PO3,PO4,PO5,PO6,PO8,PO10 /PSO1, PSO2,PSO3,PSO4

FOURTH SEMESTER

EDB 4001: Creating an Inclusive School

Objective: *The course will enable the student teachers to gain knowledge on Policy and legislative frameworks promoting inclusion and learn to create inclusive classrooms using inclusive pedagogy – (teaching strategies, CCE) by understanding the linkages and collaborations for resource mobilization.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Conceptual Formation of Inclusive School** 1.1 Concept, objectives and need of Inclusive Education, 1.2 Difference between Special Education, Integrated Education and Inclusive Education. 1.3 Constitutional provision and government policies. **1.3.1** Rehabilitation Council Of India Act 1992, **1.3.2** Sarva Shiksha Abhiyan(Ssa), **1.3.3** Persons With Disabilities Act (Pwd) 1995.	20
UNIT II	**Conceptual Framework of Children with Special Need** **2.1** Meaning and Nature of Diversities in the Classroom. **2.2** Concept and classification of Children With Special Need. **2.3** Classification Of Children With Special Need. **2.3.1** Hearing Impaired Children **2.3.2** Visually Impaired Children. **2.3.3** Physically Challenged Children. **2.4** Factors affecting the Children with Special Need.	20
UNIT III	**Curriculum Provision and Supportive Services in an Inclusive School** 2.5 Curriculum and Co-Curriculum Modification reference to Children With Special Need. (Visually Impaired, Hearing Impaired, Locomotors Disabled, Mentally Retarded) 2.6 Guidance and Counseling Services in Inclusive School. 2.7 Supportive Services of Parents, Community and Special Teacher.	20
UNIT IV	**New Approaches to Streamline Diversities in Inclusive Classroom** **4.1** School Readiness and Support Services for Inclusive Education. **4.2** Teacher Competencies, role of Class Teachers and Resource Teachers in Inclusive , **4.3** Teaching-Learning Strategies in Inclusive Education: **4.3.1** Co- Operative Learning, **4.3.2** Peer Tutoring, **4.3.3** Social-Learning, **4.3.4** Multisensory Learning ,	20

Practicum/Internal Work : (Any One)

- Preparation of status report of internship school of children with diverse needs.
- Evaluation of text book of any one subject from the perspective of differently able children.
- Prepare a report on Sarva Shiksha Abhiyan(Ssa).
- Make a list of existing resources in the local area and discuss their use and limitation based on survey of two inclusive schools.

Reference Books:

- R.S. Pandey and Lal Adwani : A book on Exceptional children.
- Bhargava : Exceptional children
- Alur Mithu and Michael Bach, (2009), The Journey For Inclusive Education In The Indian Sub- Continent. UK: Routledge
- Dettmer, p., Dyck,N.and Thurston, L.P.(1999). Consultation collaboration and teamwork for students with special needs, Needham Heyats, M.a Allyn &Bacon Epstein, C. (1984) Special Children in Regular Classrooms. Virginia: Reston Publishing Company, Inc
- Frostig, M, and, P. Maslow (1973) Learning Problems in the Classroom: Prevention and Remediation. New York: Grune & Stratton.
- Jorgensea, C.M.ed(1998). R restructuring High Schools for all Students: Taking inclusion to the next level, Baltimore: Paul H. Brookes.
- Hallahan, D & Kauffman, J.M. (1991). Exceptional Children: Introduction to special Education, Englewood, NJ: Prentice Hall.

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4 & CO5

Outcome:

After completion of this course the student teacher will able:

CO1: To understand the need to address the children with diversities.
CO2: To identify the causes for classifying various diversities.
CO3: To describe various concepts of inclusive Education.
CO4: To implement suitable curricular programme.
CO5: To apply supportive services to include children with diversities in main stream.

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

COs	POs/ PSOs
CO1	PO1,PO2,PO4,PO7,PO10 /PSO1, PSO2,PSO4
CO2	PO1,PO2,PO4,PO7,PO10 /PSO1, PSO2,PSO4
CO3	PO1,PO2,PO4,PO7,PO10 /PSO1, PSO2,PSO4
CO4	PO1,PO2,PO4,PO7,PO10 /PSO1, PSO2,PSO4
CO5	PO1,PO2,PO4,PO7,PO10 /PSO1, PSO2,PSO4

EDB 4002: Gender, School & Society

Objective:

The course will enable the student teachers to develop basic understanding and familiarity with key concepts-gender, gender bias, gender stereotype, empowerment, gender parity, equity and equality, patriarchy and feminism and transgender know about policies, plans and schemes of the government for addressing all forms of disparities and inequalities existing in the society.

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Gender Issues: Key Concepts** **1.1** Concept of Gender and Social construction of Gender. **1.2** Gender socialization and Gender Roles. **1.3** Gender discrimination at different levels of institutions.	15
UNIT II	**Socialization Processes in India: Family, School and Society** **2.1** Gender Identities and socialization practices in different types of families in India. **2.2** Gender Concerns related to access, enrolment, retention, participation and overall achievement. **2.3** Gender Issues in Curriculum**;** gender, Culture and Institution: Intersection of class, caste, religion and region, **2.3.1**Construction of gender in curriculum frameworks since Independence: An Analysis Gender and the hidden curriculum, **2.3.2**Gender in text and classroom processes, **2.3.3** Life skills and sexuality.	25
UNIT III	**Gender Jurisprudences (Indian Context)** **3.1** Prenatal diagnostic Technique Act, 1994. **3.2** The draft sexual Law Reforms in India, 2000. **3.3** Domestic Violence Act, 2005. **3.4** Reservation for Women. **3.5** Supreme Court Verdict about transgender.	20
UNIT IV	**Creating Gender Inclusive Classroom** **4.1** Developing positive self concept and self esteem among girls. **4.2** Overcoming Gender Stereotypes. **4.3** Working towards gender equality in the classroom: Need and Strategies. **4.4** Teacher as an agent of change.	20

Practicum/Internal work :(any one)

- Analyses Textbooks of Class VI to X (of your State) from the Perspective of Gender Bias and Stereotypes.
- Observe Participation of Boys and Girls in different Activities in Heterogeneous Schools-Public and Private-Aided and managed by Religious Denominations and prepare a report.
- Collect material related to Women Role Models in various fields with Emphasis on Women in Unconventional Roles and prepare a brief report.

- Analysis of the Films post screening of the following: Bawander, India's Daughter, Water.

Reference Books:

- Desai, Neera and Thakkar, Usha. (2001).Women in Indian Society. National Book Trust,New Delhi
- Dunne, M. et al. (2003). Gender and Violence in Schools. UNESCO
- Kirk Jackie (ed) , (2008),Women Teaching in South Asia, SAGE, New Delhi
- Leach, Fiona. (2003).Practising Gender Analysis in Education, Oxfam
- NCERT 2006, National Curriculum Framework 2005: Position Paper, National Focus Group on Gender Issues in Education, New Delhi
- Nayar, Sushila and Mankekar Kamla (ed.) 2007, _Women Pioneers in India's Renaissance,National Book Trust, New Delhi, India.
- Sherwani, Azim. (1998).The Girl Child in Crisis. Indian Social Institute, New Delhi.
- Srivastava Gouri, (2012), Gender and Peace in Textbooks and Schooling Processes, Concept Publishing Company Pvt. Ltd, New Delhi
- Unterhalter, Elaine. (2007).Gender, Schooling and Global Social Justice, Routledge.

Focus: This Course is focusing on employability, entrepreneurship and skill development under the CO1, CO2, CO3 & CO4

Outcome:

After completion of this course the student teacher will able:

CO1: To develop basic understanding and familiarity with key concepts-gender, Gender bias, Gender stereotype, Empowerment, Gender parity, Equity and Equality, Patriarchy and Feminism and transgender.

CO2: To know about policies, plans and schemes of the government for addressing all forms of Disparities and inequalities existing in the society.

CO3: To learn about gender issues in school, curriculum, textual materials across disciplines, Pedagogical processes and its intersection with class, caste, religion and region.

CO4: To understand the need to address gender based violence in all social spaces and evolve Strategies for addressing it.

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

COs	POs/ PSOs
CO1	PO1,PO2,PO3,PO8,PO10 /PSO1, PSO2,PSO4
CO2	PO1,PO2,PO3,PO8,PO10 /PSO1, PSO2,PSO4
CO3	PO1,PO2,PO3,PO8,PO10 /PSO1, PSO2,PSO4
CO4	PO1,PO2,PO3,PO8,PO10 /PSO1, PSO2,PSO4

EDB 4003: Assessment for Learning

Objective: *The course will enable the student teachers to gain a critical understanding of issues in assessment and evaluation (from multiple perspectives with focus on constructivist paradigm),become cognizant of key concepts such as formative and summative assessment, evaluation and measurement, test, examination and be exposed to different kinds and forms of assessment that aid student learning.*

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

Module No./Unit	Content	Teaching Hours
UNIT I	**Assessment and Evaluation in Education** **1.1** Concept of Measurement, Assessment and Evaluation. **1.2** Need, scope and Types (Teacher-made and Standardized test) **1.3** Principles of Assessment and Evaluation **1.4** Types of scale: Nominal, Ordinal, Interval and Ratio	20
UNIT II	**Tools and Techniques of Assessment and Evaluation** **2.1** Characteristics of a good measuring instrument; **2.1.1** Validity **2.1.2** Reliability **2.1.3** Norms **2.2** Techniques of Evaluation: Observation, Interview, Questionnaire, Rating scale, Checklist and Cumulative Record. **2.3** Self-assessment and Feedback **2.4** Planning and Preparation of an Achievement test (Including blue print) (Objective Type Test, Subjective Type Test)	20
UNIT III	**New Trends in Evaluation (Need and Use)** **3.1** Continuous and Comprehensive Evaluation **3.2** Marking system **3.3** Grading system **3.4** Question bank	20
UNIT IV	**Statistics Applicable in Assessment for Learning** **4.1** Concept and Nature of statistics, Collection and Tabulation of data **4.2** Measures of Central Tendency- Mean, Median and Mode (Meaning, computation & uses) **4.3** Measures of Dispersion-Range, Mean Deviation, Quartile Deviation and Standard Deviation (Meaning, computation & uses) **4.4** Correlation: (I) Meaning (II) Calculation of correlation (rank difference method)	20

Practicum/Internal work:(Any one)

- Develop a Question paper for secondary class to assess all the aspects of any one subject.
- Prepare a blue print of any one subject you taught during School Internship.
- Prepare Result of any class you taught during School Internship.
- Prepare one Multiple choice Question Paper.

Reference Books:

- Aggarwal, Y.P. (2002). Statistical Methods: Concepts, Applications and Computation. New Delhi: Sterling Publishers Pvt. Limited.
- Anastasi, A. (1976). Psychological Testing. New York: McMillan Publishing Co., Inc.
- Asthana, B. (2008). Measurement and Evaluation in Psychology and Education. Agra:

Agrawal Publications.
- Bhargava, M. and Mathur, M. (2005). Psychometrics and Statistical Applications in Educational and Behavioural Sciences. Agra: H. P. Bhargava Book House.
- Choube. P. S (1998). A Guide to Psychology Experiments and Statistical Formulas. Agra: Vinod Pustak Mandir.
- Ferguson, G.A. (1976). Statistical Analysis in Psychology and Education. Tokyo: McGraw Hill Kogakusha Limited.
- Guilford, J.P. and Fruchter, B. (1970). Fundamental Statistics in Psychology and Education. New York: McMillan Publishing Co., Inc.
- Gupta, C.B. and Gupta, V. (1995). An Introduction to Statistical Methods. Kanpur: Vikas Publishing Pvt. House

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5, CO6 and CO7

Outcome:
After completion of this course the student teacher will able:

CO1: To distinguish Measurement, Assessment and Evaluation.
CO2: To explain different forms of Assessment that aid student learning.
CO3: To use and construct wide range of Assessment Tools and Techniques.
CO4: To evolve realistic, comprehensive and dynamic Assessment procedures.
CO5: To calculate item difficulty and discrimination power of a test item.
CO6: To realize the importance of Continuous and Comprehensive Evaluation in the process of students learning.
CO7: To describe the role of Assessment in Education.

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

COs	POs/ PSOs
CO1	PO1,PO2,PO3,PO7,PO10 /PSO1,PSO2, PSO4
CO2	PO1,PO2,PO3,PO7,PO10 /PSO1,PSO2, PSO4
CO3	PO1,PO2,PO3,PO7,PO10 /PSO1,PSO2, PSO4
CO4	PO1,PO2,PO3,PO7,PO10 /PSO1,PSO2, PSO4
CO5	PO1,PO2,PO3,PO7,PO10 /PSO1,PSO2, PSO4
CO6	PO1,PO2,PO3,PO7,PO10 /PSO1,PSO2, PSO4
CO7	PO1,PO2,PO3,PO7,PO10 /PSO1,PSO2, PSO4

EDB 4004: Environmental Education

Objective: *The course will enable the student teachers to understand possible environmental hazards their negative effects and method to minimize them also establish the relationship of man with environment.*

Credits: 02 **L-T-P-J: 2-0-0-0**

Module No./Unit	Content	Teaching Hours
UNIT I	**Basic Concept and Nature of Environment** **1.1** Concept and meaning of Environment- Natural and man-made environment. **1.2** Ecosystem- structure, function and components. **1.3** Food chains, food webs and ecological pyramids. **1.4** Introduction and characteristic features of – forest, grass land, desert.	16
UNIT II	**Natural Resources and associated problems** **2.1** Forest resources- use and over-exploitation and deforestation- causes, effects and remedies. **2.2** Water resources- use and over-exploitation of surface and ground water conservation, rain water harvesting and watershed management. **2.3** Food resources- world food problems- changes caused by agriculture and overgrazing, effect of modern agriculture, Fertilizers, pesticides, water logging and Salinity.	16
UNIT III	**Environmental Issues and Preventive Measures** **3.1** Air, water and marine pollution. **3.2** Noise, thermal and nuclear Pollution. **3.3** Solid waste- causes, effects and controlling measures of urban and industrial waste. **3.4** Climate change- global warming, acid rain and ozone layer depletion. **3.5** Natural Disaster – flood, earthquake, cyclone and land slides	16

Practicum/Internal work:

Preparation of survey report of any public place:

- Railway station,
- Bus stand,
- Hospital,
- Industrial area etc.

Reference Books:

- Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad - 380013,India, Email: mapin@icenet. net (R).
- Cunningham, W.P.Cooper, T.H. Gorhani, E & Hepworth, M.T.2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p.
- Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay
- Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment Cambridge Univ. Press 1140p.

- Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws Himalaya Pub. House, Delhi 284 p.
- Mckinney, M.L. & School, R.M. 1996. Environmental Science systems &Solutions, Web enhanced edition. 639p.
- Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
- Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut.
- हरिचन्द्र व्यास (2001) पर्यावरण शिक्षा, नई दिल्ली, विद्या बिहार।
- सक्सैना हरिमोहन (2003) पर्यावरण अध्ययन, श्री गगांनगर, अग्रवाल साहित्य सदन।
- सक्सैना ए.बी. (1998) पर्यावरण शिक्षा नई दिल्ली, आर्थ बुक डिपो।
- NCERT (1981) Environmental Education at school level, New Delhi.

Focus: This Course is employable under the CO1, CO2, CO3 & CO4

Outcome:

After completion of this course the student teacher will able:

CO1: To understand the concept, aims and objectives of environmental education.

CO2: To understand possible environmental hazards and their negative effects and method to minimize them.

CO3: To establish the relationship of man with environment.

CO4: To appreciate the role of various agencies working in the area of environment.

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

COs	POs/ PSOs
CO1	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO2	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO3	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO4	PO2,PO7,PO9,PO10 /PSO1, PSO4

EDB 4005: Peace Education

Objective: *The course will enable the student teachers to understand* Peace education its relevance and connection to inner harmony as well as harmony in social relationships.

Credits: 02 **L-T-P-J: 3-0-0-0**

Module No./Unit	Content	Teaching Hours
UNIT I	**Understanding peace: as a Dynamic Social Reality** **1.1** Peace Education – meaning, nature & scope, Need and importance of peace education. **1.2** Human Rights and peace Education. **1.3** Peace Education and conflict resolution in school. **1.4** Frontiers of Education for peace - Personality formation, living together in Harmony, Responsible citizenship, National Integration, Education for peace as a life style movement.	16
UNIT II	**Orienting Education for Peace Building** **2.1** Education for Peace – Values and Life Skills **2.2** Designing Programmes – Ways of Integrating peace into the curriculum, Practice that make school a place of peace, teacher as peace builders, pedagogical skills and strategies, integrating peace concerns in classroom transaction.	16
UNIT III	**Role of Various Philosopher & Thinkers of Peace** **3.1** Concept of peace according to – Gandhi, Krishnamurthy, Aurobindo, Mother Teressa, Initiatives at National and International levels. **3.2** Agencies contributing to peace – UNO, Gandhi Peace foundation etc.	16

Practicum/Internal work: (Any One)

- Preparation of collages from newspapers magazines etc. to highlight issues and challenges to peace or positive response to them.
- Prepare a poster based on the classification of peace values.
- Case study of a child suffering from stress & tension or bad habits.

Reference Books:

- Balasovriya, A.S. (1994) Teaching Pace to Children, National Institute of Education Maharagama, Sri Lanka.
- Balasovriya, A.S. (2000) World Peace through School National Institute of Education, Maharagama.
- Canfeid, Jack (1975) 101 Ways to enhance self concept in the classroom, Prentice Hall, Engle Cliffs.
- Fountain, Suan (1988) Learning together – Global education, Stanley Thrones Publishers, Ltd. York University.
- Graham and David Seiby (1993) Global Teacher – Global learner, Hodder and Stoughton Ltd., London.
- Kreidler Willam, I, (1991) Creative Conflict Resolution more than 200 activities for keeping pace in the Classroom,

- Foreman, Scott, Glenview Learning the way of Peace, A Teachers Guide to Peace Education (2001) United Nations Educational Scientific and Cultural Organization, New Delhi.

Focus: This Course is employable under the CO1, CO4 & CO7

Outcome:

After completion of this course the student teacher will able:

CO1: To explain and know about peace education, their relevance and connection to inner harmony as well as harmony in social relationships.
CO2: To study about Human Rights and peace Education.
CO3: To study and understand the views of different philosophies about peace.
CO4: To know how peace education in helpful in conflict resolution.
CO5: To study the ways of integration peace into the curriculum
CO6: To study how teacher can be as peace builder
CO7: To use pedagogical skills and strategies in and out of classroom for promoting peace.
CO8: To understand and resolve conflicts within self and in society.

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

COs	POs/ PSOs
CO1	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO2	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO3	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO4	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO5	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO6	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO7	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO8	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4

EDB 4006: Population Education

Objective: *The course will enable the student teachers to understand* importance of population, factors responsible for population growth and Educational intervention for upgrading the quality of Social functioning.

Credits: 02 **L-T-P-J: 3-0-0-0**

Module No./Unit	Content	Teaching Hours
UNIT I	**Concept of Population Education** **1.1** Introduction: Concept, Need, Scope, Importance and Objectives. **1.2** Population dynamics: distribution and density, population composition according to age, sex, rural, urban, literacy-all India. **1.3** Factors affecting the Population growth: Fertility, Mortality and Migration(mobility). **1.4** Population and quality of Life: Population in relation To Socio-Economic Development, Health Status, Nutrition Health Services and Education.	16
UNIT II	**Scope, Curriculum, Methods &Approaches of Population Education** **2.1** Scope of Population Education in Schools. **2.2** Curriculum of Population Education in Schools-Integration of Population Education with the general School Curriculum. **2.3** Methods and Approaches: Inquiry Approach, Observation, Self-Study, Discussions, Assignment. **2.4** Use of Mass-Media: Newspapers, Radio, Television, A.V. Aids.	16
UNIT III	**Role of Teacher & Different Agencies in Population Education** **3.1** Role of Teachers in Creating Awareness of the Consequences of Population problems inculcating New Values and Attitudes leading to Modification of Student Behavior. **3.2** Working with Community to build Awareness. **3.3** Role of Central and State Government in Population Control and Health Preservation: National Population Policy , various Population related Policies and Programmers, Voluntary and International Agencies –UNEPA, WHO, UNESCO etc.	16

Practicum/Internal Work:

- Population Survey of a nearby Community.
- Preparing a report of an exhibition concerning Population Education.
- An Essay (about 200 words) on the role of Mass – Media in Population control.

Reference Books:

- Mehta, T.S. & Pathak B.S.: Population Education for Teachers NCERT Publication.
- Mehta, T.S. and Chandrar: Population Education: Selected Reading NCERT Publication.

- Mehta, T.S. Saxena, R.C. & Mukharjee: Reading in population in Education NCERT Publication.
- Wadia, A.B.: Population Education for young on the Nature and Methodolog of Population
  Education FPAT,Mumbai. FPAL, Mumbai.
- UNESCO: Reading on the Nature and Methodology of Population Education Bangkok, 1982.
  Bangkok, 1982.
- Vyas & Vyas : Population : Problem and Solution, Asha Prakashan Grah 30, Naiwala, Karol Bag, New Delhi-5

Focus: This Course is employable under the CO1, CO2, CO3, CO4 & CO5

Outcome:

After completion of this course the student teacher will able:

CO1: To develop in the student-teacher an understanding of the concept, and importance of Population Education.
CO2: To enable the students to understand various terminologies connected with Population studies and factors responsible for population growth.
CO3: To develop an awareness of the implications of population growth on various aspects of social functioning.
CO4: To help student-teacher to understand the effect of unchecked growth of population of the depletion of Natural resources from the Environment.
CO5: To help student-teacher to appreciate the role of Population Education as an Educational intervention for upgrading the quality of Social functioning.

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

COs	POs/ PSOs
CO1	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO2	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO3	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO4	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4
CO5	PO2,PO5,PO7,PO8,PO10 /PSO1, PSO2,PSO4

EDB 4007: School Administration and Management

Objective: *The course will enable the student teachers to understand* educational management its resources, organizations, time management, and quality classroom management.

Credits: 02 **L-T-P-J: 3-0-0-0**

Module No./Unit	Content	Teaching Hours
UNIT I	**Concept of School Administration and Management** **1.1** Concept of School Administration and School Management. **1.2** Difference between School Administration and School Management**;** Process of Educational management.	16
UNIT II	**Role of Educational Agencies in India at different level-** **1.1** Central Agency – NCERT, CBSE,NIOS **1.2.** State Agency-SCERT, Local Agency-DIET.	16
UNIT III	**Management of School Education** **2.1** School Personnel: Headmaster/Principal, Teacher-Qualities and Duties. **2.2** Concept of Supervision**:** Aims, Types & Techniques of Supervision. **2.3** Leadership –Concept of Leadership**,** Theories of Leadership. **2.4** Discipline**:** Concept, Types, Causes of Indiscipline.	16

Practicum/Internal work (Any One)

School plant –

- Essential characteristics of a school campus,
- Types of school building,
- Components of school building (the class room, library room, science laboratory playground, the hostel)

Co-curricular activities –

- Types of co-curricular activities and
- Organize one co-curricular activity in school, give review.

Maintenance of school records –

- Types of school records.
- School Calendar, Class time –table.
- Admission register, Teacher Attendance Register.
- Annual Examination Result Register, log book.

Reference Books:

- Chandrashekaran Pramila: Educational Planning and Management: Sterling publishers: New Delhi: 1994
- Dash B.N., School Organization, Administration and management NeelkamalPublication Pvt. Ltd. Newdelhi, (2004)
- Franklin G Stephen & Terry R. George: Principles of Management AITBS Pub., New Delhi
- Jagannath Mohanthy, Educational Administration supervision and school management,Deep & deep publishers (2004)

- Khana, S.D. Saxena V.K. Lamba, T.P. Murthy. V; Educational Administration Planning, Supervision and financing: Doaba House, Delhi 2000
- Kochhar S.K., Secondary School Administration, Sterling Publishers (1996)
- Mathur .S.S: Educational Administration and Management, the associated publishers, New Delhi 1990.
- Myageri C.V: Textbook of Educational Management, Vidyanidi Prakashana,Gadag 1993.
- N.P.Rao: Education and Human Resource Management, APH Pub. Corp., New Delhi 1996.
- Panda. U.N.: School Management, D.K. Publishers(P) Ltd., New Delhi 1989.
- Pandya. S.R. Administration and Management of Education, Himalaya Publishing House, New Delhi
- Parti. R. Vasanthi: Education in India, Indian Institute of Counselling, New Delhi 2000.
- Ravi Shankar S. & K.S. Bhat: Administration of Education, Seena Pub., Delhi 1985. (1971)
- Sachdev M.S.: A New Approach to school management New Academic Publishing Co., Julandhar 2000.
- Sultan Mohiyuddin & Siddalingaiya M, Schol Organization and management, DPI Publishers,(1958)
- Sultan Mohiyuddin and Dr. Siddalingaiah: School organization and Management

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5 & CO6

Outcome:

After completion of this course the student teacher will able:

CO1: To meaning, purposes and process of Educational Management.
CO2: To management of resources in secondary schools.
CO3: To organization and management of School programs.
CO4: To the concept and importance of time management.
CO5: To the importance of student's discipline and classroom management.
CO6: To the factors affecting the total quality management.

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

COs	POs/ PSOs
CO1	PO1,PO6,PO8,PO10 /PSO1, PSO2,PSO3
CO2	PO1,PO6,PO8,PO10 /PSO1, PSO2,PSO3
CO3	PO1,PO6,PO8,PO10 /PSO1, PSO2,PSO3
CO4	PO1,PO6,PO8,PO10 /PSO1, PSO2,PSO3
CO5	PO1,PO6,PO8,PO10 /PSO1, PSO2,PSO3
CO6	PO1,PO6,PO8,PO10 /PSO1, PSO2,PSO3

EDB 4008: Value Education

Objective: *The course will enable the student teachers to* develop good moral character through Value Education *and understand* relation between Value and personal behavior affecting the achievement of sustainable future.

Credits: 02 **L-T-P-J: 3-0-0-0**

Module No./Unit	Content	Teaching Hours
UNIT I	**Concept of Value Education** **1.1 Value** Education: Concept, Need, Nature and Sources. **1.2** Classification of values. **1.3** Views of NCFTE, 2009 for Value Education. **1.4** Celebration of Value based Activities for Promoting National Values. **1.5** Constitutional Values.	16
UNIT II	**Nurturing Agencies** **2.1 Formal** -School- Co Curricular and Curricular Activities 2.2 Informal-Home and Society 2.3 Non formal-Mass Media	16
UNIT III	**Value Crisis** **3.1** Scenario of erosion of value in Modern Society. **3.2** Challenges of disseminating values in the millennium. **3.3** Methods and Techniques for improving the Social Ecology. **3.4** Role of Education in diluting value crisis.	16

Practicum/Internal work: (Any One)

- Content analysis of one teaching subject regarding development of values.
- Prepare the list of activities and their related values in School.
- Write a short story on any one value

Reference Books:

- पाण्डेय, बृजेश, (2002), मूल्यपरक शिक्षा : वर्तमान परिदृश्य, भारतीय आधुनिक शिक्षा
- पाण्डेय, रामशक्ल, एवं मिश्रा, करूणा शंकर, (2006), मूल्य शिक्षण, विनोद पुस्तक मंदिर,आगरा
- मिश्रा, रेणु, मूल्यपरक शिक्षा, राजस्थान बोर्ड शिक्षण पत्रिका, अंक : 3–4, खण्ड 44–4
- मोदी, विकास, (2006), नैतिक मूल्य व शिक्षा, शिविरा पत्रिका, जुलाई
- राधाकृष्णन्, एस. : जीवन का आदर्श दृष्टिकोण
- लोढ़ा, महावीरमल, (1996), नैतिक शिक्षा के विविध आयाम, राजस्थान हिन्दी ग्रन्थ अकादमी,जयपुर
- शर्मा, गणपतराय एवं व्यास हरिश्चन्द्र (2008), उदीयमान भारतीय समाज और शिक्षा,
- राजस्थान हिन्दी ग्रन्थ अकादमी, जयपुर
- सक्सैना, एन.आर. स्वरूप व पाण्डेय, कामता प्रसाद (2004), शिक्षा के दार्शनिक एव
- समाजशास्त्रीय सिद्धान्त, आर. लाल. बुक डिपो, मेरठ
- गोयेयन का जयदयाल–महत्वपर्ण शिक्षा, गीता प्रेस गोरखपुर

उर्वशी सरती–नैतिक शिक्षा एवं बाल विकास प्रभात प्रकाशन, चावड़ी बाजार दिल्ली।

Gupt N.L.Value Oriented Education,Krishna brothers,Ajmer

- Prem Kripal-Value in Education NCERT, New Delhi 1981
- Swami Raghunath Anand- Eternal values for a changing society, BVB Bombay1971

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5 & CO6

Outcome:

After completion of this course the student teacher will able:

CO1: To develop good moral character through Value Education.
CO2: To built good teacher through Value Education.
CO3: To develop and understanding of Value Education strategies.
CO4: To consider the relation between Value and personal behaviour affecting the achievement of sustainable future.
CO5: To reflect on your future awareness, commitment and actions.
CO6: To develop skills for using values clarification and values analysis in teaching.

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

COs	POs/ PSOs
CO1	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO2	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO3	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO4	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO5	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO6	PO2,PO7,PO9,PO10 /PSO1, PSO4

EDB 4080: Soft Skills & Personality Development

Objective: *The course will enable the student teachers to* enhance holistic development of their personality, effective verbal and non-verbal communication skills, grooming and etiquettes and conflict resolution techniques.

Credits: 03 **L-T-P-J: 0-0-6-0**

Module No./Unit	Content	Teaching Hours
UNIT I	**Introduction to Personality Development** Concept of 'Persona', Self Awareness, SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem	10
UNIT II	**Goal Setting and Time Management** SMART goals, Importance of time, Preparation of goals and Allocation of time in timeline, Preparation of personal time table, Multitasking	10
UNIT III	**Team Building** Benefits of Team Building; Steps: Forming, Norming, Storming, Performing; Importance of Interpersonal Relationships, Empathy, Motivating Team	10
UNIT IV	**Communication** Components of effective communication; Communication process; Non–Verbal Communication :its importance and nuances :Facial Expression , Posture ,Gesture , Eye contact, appearance(dress code); Methods to improve communication (practical).	12
UNIT V	**Etiquettes and Grooming** Dress for success; Carrying oneself and projecting a positive image, General mannerism and Etiquettes	10
UNIT VI	**Stress Management** Kinds of Stress: Eustress and Distress; Handling pressure and perform efficiently, Techniques to cope with stress at workplace; Emotional Intelligence, managing emotions	12
UNIT VII	**Leadership** Types of leaders-Positional versus Situational leadership; Skills of a good leader, Leadership in a team	10
UNIT VIII	**Conflict Resolution** Conflicts in a team, Case studies, Approaches to resolve conflicts, Importance and necessity of decision making, Win-Win Scenario, Weighing positives and negatives	12
UNIT IX	**Public Speaking** Diction, Clarity, Loudness, Modulation; Audience Engagement, Improve Public Speaking, Role Plays, Presentations, Debates	10

Reference Books:

- Covey, Sean. Seven Habits of Highly Effective Teens, New York, Fireside Publishers, 1998.
- Carnegie, Dale. How to win Friends and Influence People, New York: Simon & Schuster, 1998.
- Bhatnagar, Nitin. Effective Communication and Soft Skills. Pearson Education, India.
- Garner, Eric. Step by Step to Magical Team Building (ebook), 2006
- Johnson, Spenser, Who moved my cheese?, RHUK, 1999
- Peace, Allan and Peace, Barbara. The definitive book on Body Language, New York, Fireside Publishers, 1998.
- Maxwell, John C. The 21 Irrefutable Laws of Leadership, Vayu Education of India, 2016
- Mackenzie, Alec and Nickerson, Pat. The Time Trap : The Classic book on Time Management (ebook): AMACOM, 2009

Focus: This Course is focusing on employability and skill development under the CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9 & CO10

Outcome:

After completion of this course the student teacher will able:

CO1: To enhance holistic development of students.

CO2: To be goal oriented and manage time.

CO3: To develop interpersonal skills and be a team player.

CO4: To develop effective verbal and non-verbal communication skills.

CO5: To improve grooming and etiquettes.

CO6: To develop problem solving skills and conflict resolution techniques

CO7: To understand and handle emotions and behaviour.

CO8: To assess and utilize the diverse skills of a group as a leader.

CO9: To develop confidence and the ability to speak to and handle a large group.

CO10: To be ready to face the various challenges of the placement process.

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

COs	POs/ PSOs
CO1	PO1 /PSO1
CO2	PO2 /PSO1
CO3	PO3 /PSO1
CO4	PO8 /PSO2
CO5	PO8,PO9 /PSO1,PSO4
CO6	PO7,PO8 /PSO1,PSO2,PSO4

CO7	PO8 /PSO1
CO8	PO2,PO5 /PSO4
CO9	PO1,PO8 /PSO1,PSO2
CO10	PO1,PO2,PO3,PO8,PO10 /PSO1,PSO4

EDB 4081: Understanding ICT and Its Application-III

Objective: *The present course focuses on moving beyond computer literacy and ICT-aided learning, to help student-teachers interpret and adapt ICTs in line with educational aims and principles. It explores ICTs along three board strands; teaching-learning, administrative and academic support systems, and broader implications for society. The course will help student-teachers reflect critically and act responsibly to prevent use of ICTs to support centralization of larger knowledge structures; it will show student-teachers how ICTs can be adapted to support decentralized structures and processes; as well as build the 'digital public' to make education a participatory and emancipatory process.*

Credits: 03 **L-T-P-J: 0-0-6-0**

Module No./Unit	Content	Teaching Hours
	Internet and Multimedia • Use of Smart Class • Use of Smart Board • Use of Virtual class • Use of Smart Lab, • Use of Digital books in Education. • Use of LED & Projector • Mobile, Printer in Class Room • Create E- Mail Account • Basics of sending and receiving E-Mails • Attaching files with them • Internet Searching – Educational content/ Data • Internet Data Downloading • Internet Data Uploading in Class-Room • Formatting Application for various purpose • Prepare Time table • Formatting Letter Head • Prepare Resume • Attendance Register • Mark list • Mark sheet • Observation Report of School • Formatting question paper • Prepare a report of Community work • Educational Chatting • Educational video calling/conferencing • Prepare power point presentation- Slides • Prepare power point presentation- using animations, sounds • Flip classes • Use of Pen drive • Write CD/DVD	96

Reference Books:

- Cox, J. & Urban, P. (1999). Quick Courses in Microsoft Office, New Delhi: Galgotia Publications.

- Jain, Satish. (1990). Introduction to Computer Science and Basic Programming, New Delhi: Prentice Hall of India.
- Saxena, S. (1998). A first Course in Computer, New Delhi: Vikas Publications.
- Sinha, P.K. (1990). Computer Fundamentals, New Delhi: BPB Publications.
- Tanenbaum, A.S. (1998). Computer Networks, New Delhi: Prentice-Hall of India.
- Intel (2003). Intel Innovation in Education, New Delhi: Student Work Book.
- Rajasekar, S. (2010). *Computers in Education.* ND: Neelkamal Publications Pvt. Ltd.

Focus: This Course is focusing on skill development under the CO1, CO2, CO3, CO4, CO5, CO6,CO7,CO8 & CO9

Outcome:

After completion of this course the students will able:

CO1: To explain the concept of ICT in education.
CO2: To develop skills in using Smart Class for Education.
CO3: To develop skills in using Virtual Class for Education.
CO4: To develop skills in using Multimedia for Education.
CO5: To develop skills in using MS Word applications for Education.
CO6: To develop skills in using MS Excel applications for Education.
CO7: To develop skills in using MS Power Point applications for Education.
CO8: To use internet efficiently to access information and communicate with others.
CO9: To understand the applications of E-learning in Education.

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

COs	POs/ PSOs
CO1	PO1,PO4,PO6 /PSO2, PSO3
CO2	PO1,PO4,PO6 /PSO2, PSO3
CO3	PO1,PO4,PO6 /PSO2, PSO3
CO4	PO1,PO4,PO6 /PSO2, PSO3
CO5	PO1,PO4,PO6 /PSO2, PSO3
CO6	PO1,PO4,PO6 /PSO2, PSO3
CO7	PO1,PO4,PO6 /PSO2, PSO3
CO8	PO1,PO4,PO6 /PSO2, PSO3
CO9	PO1,PO4,PO6 /PSO2, PSO3

EDB 4082: Working with Community

Objective: *The course will enable the student teachers to* develop Social – sensitivity sympathy with the poor and the people below poverty line, and develop awareness about the environment.

Credits: 02 **L-T-P-J: 3-0-0-0**

Module No./Unit	Content	Teaching Hours
UNIT I	This can be achieved by organizing a number of programme for the welfare of the community, like – • To educate the dropouts and adults (Literate India) • To educate the people of slum areas to take the nutritious diet. (Quit Mal-nutritious). • To make the people learn the importance of small family norm (Chota Pariwar Sukhi Pariwar) • To make the people learn the importance of the girls-child & its education for the Family and the society (Beti Bachao Beti Padhao) • To motivate the people to grow more plants (Green India) • To Motivate the people to keep the city and the public places clean (Clean India) • To motivate the people to save river and ponds (Clean Water)	64

Reference Books:

- पाण्डेय, बृजेश, (2002), मूल्यपरक शिक्षा : वर्तमान परिदृश्य, भारतीय आधुनिक शिक्षा
- पाण्डेय, रामशक्ल, एवं मिश्रा, करूणा शंकर, (2006), मूल्य शिक्षण, विनोद पुस्तक मंदिर,आगरा
- मिश्रा, रेणु, मूल्यपरक शिक्षा, राजस्थान बोर्ड शिक्षण पत्रिका, अंक : 3–4, खण्ड 44–4
- मोदी, विकास, (2006), नैतिक मूल्य व शिक्षा, शिविरा पत्रिका, जुलाई
- राधाकृष्णन्, एस. : जीवन का आदर्श दृष्टिकोण
- लोढ़ा, महावीरमल, (1996), नैतिक शिक्षा के विविध आयाम, राजस्थान हिन्दी ग्रन्थ अकादमी,जयपुर
- शर्मा, गणपतराय एवं व्यास हरिश्चन्द्र (2008), उदीयमान भारतीय समाज और शिक्षा,
- राजस्थान हिन्दी ग्रन्थ अकादमी, जयपुर
- सक्सैना, एन.आर. स्वरूप व पाण्डेय, कामता प्रसाद (2004), शिक्षा के दार्शनिक एव
- समाजशास्त्रीय सिद्धान्त, आर. लाल. बुक डिपो, मेरठ
- गोयेयन का जयदयाल–महत्वपर्ण शिक्षा, गीता प्रेस गोरखपुर

  उर्वशी सरती–नैतिक शिक्षा एवं बाल विकास प्रभात प्रकाशन, चावड़ी बाजार दिल्ली।

  Gupt N.L.Value Oriented Education,Krishna brothers,Ajmer
- Prem Kripal-Value in Education NCERT, New Delhi 1981
- Swami Raghunath Anand- Eternal values for a changing society, BVB Bombay1971

Focus: This Course is focusing on skill development under the CO1, CO2, CO3 & CO4

Outcome:

After completion of this course the student teacher will able:

CO1: To develop Social – sensitivity among student-teachers.
CO2: To develop sympathy with the poor and the people below poverty line.
CO3: To develop awareness about the environment.
CO4: To have the positive attitude toward the neglected class.

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

COs	POs/ PSOs
CO1	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO2	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO3	PO2,PO7,PO9,PO10 /PSO1, PSO4
CO4	PO2,PO7,PO9,PO10 /PSO1, PSO4

Syllabus

Doctor of Philosophy

(Ph.D. in Education)

Faculty of Education

Paper Code: PED 1001 Philosophical and Sociological Basis of Educational Research

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

Objectives of the Course:

- To understand the indispensable role of Philosophy and Sociology in Education.
- To initiate scholars to the process of critical reflection of texts pertaining to the Philosophy of Education.
- To acquaint them about the ideas of thinkers in the realm of Education.
- To develop a critical understanding of the relationship between Philosophy and Education and
- Sociology and Education in the context of interdisciplinary in research.

Unit —I: Philosophy as a Discipline and its Role

A. Philosophy a Liberal Discipline: Meaning and Relevance
B. Functions of Philosophy: Speculative, Analytic, Prescriptive and Normative
C. Philosophical Methods: Analysis, Synthesis, Induction, Deduction
D. Education and Philosophy: meaning, relationship, nature, scope and significance of studying philosophy in education.

Unit-Il: Western and Indian Thinkers on Education

A. Immanuel Kant-Idealism
B. John Dewey-Progressivism
C. Jean Paul Sartre-Existentialism
D. Rabindranath 'Tagore-Individualism
E. Sri Aurobindo- integral Education
F. Vivekananda-Man making Education

Unit-III: Sociology and' Education.

A. Concept of Educational Sociology and Sociology of Education.
B. Social Change: Meaning, Nature and Causes. Constraints of social change (caste,
C. Ethnicity, class, language, religion, regionalism).
D. Education as an agent of Social and Economic change, and HRD.
E. Education for social stratification and social mobility. Democracy and Education.

Unit IV-Contemporary issues to Education

A. Women Education and Gender Equity.
B. Globalization: Concept and its Relevance in Contemporary Situation.
C. Human Rights and Education with Special reference to Rights of Children. Consumer Rights and Right to Education.
D. Education for Peace. Values: concept, need, sources.
E. WHO-Life Skills

Focus: This Course is employable under the CO1, CO2 and CO3

Outcome:

After completion of this course the researcher will able:

CO1 : To understand the indispensable role of Philosophy and Sociology in Education.
CO2 : To initiate scholars to the process of critical reflection of texts pertaining to the Philosophy of Education.
CO3 : To acquaint them about the ideas of thinkers in the realm of Education.

CO4 : To develop a critical understanding of the relationship between Philosophy and Education and
CO5 : Sociology and Education in the context of interdisciplinary in research.

References:

Brubacher (1950) Modern Philosophies of Education, McGraw Hill Book Co. New York

• Krishnamurthi, J Education and the Significance of life, KFI Publications.

• Kumar Krishna (2004) What is Worth teaching/ 3rd Edition Orient Longman

• Gandhi M K (1956) Basic Education, Ahmedabad, Navjivan.

• Giroux Henry (2011) On Critical Pedagogy, Continuum Press.

• Govt. of India (1952) Report of the Secondary Education Commission, New Delhi

• Govt. of India, MHRD (1986, Revised 1992) National Policy of Education, New Delhi.

• Govt. of India, MHRD (1992) Programme of Action (Draft) New Delhi, Aravalli Printers and Publishers.

• Paulo Freire (1996) Pedagogy of the Oppressed, Penguin Books.

• Mani R S (1964) Educational Ideas and Ideals of Gandhi and Tagore, New Book Society New Delhi:

• Noddings Nel (2012) Philosophy of Education, west view Press.

Paper Code-PED 1002: Recent Development to Indian Education: Policy Directive and Programme

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

Objectives:

- To acquaint the researcher with new knowledge pedagogies ad approaches for teaching
- To sensitize towards the need of revamping teacher education to ensure quality
- To understand the need of assessment, standards, and management in Education System
- To develop an understanding of total quality management system in education
- To analyse the policy, programme and recent trades pertaining to Indian Education System.

Units: I Knew Knowledge Pedagogies and approaches in Educational Research

A. Ensuring Learning out come in Elementary Education
B. Extending out reach of secondary and senior secondary Education
C. Strengthening Vocational Education, Accelerating Rural Literacy, Adult education and National Open Schooling Systems
D. Promotion of Information and Communication Technology in Education.

Unit -II: Revamping Teacher Education for Quality Improvement

A. Recent trends in Teacher Education and Present Scenario
B. Issus related to Teacher Education programmes in India with reference to pre service and in - service Teacher Education programme
C. Inclusive pedagogy and its challenges for revamping Teacher Education .
D. Role of UGC based Teacher Education for promoting research in teacher Education, Fund and grant system, Assessment and Management Systems.

Unit - III : Standards , School Assessment and School Management .

A. Total Quality Management Concept - indicators of quality , setting standards for performance
B. Institutional Autonomy and Accountability
C. Assessment and accreditation in Education
D. Role of ISO, QCI and NAAC

Unit - IV : Indian Education : Planning and policy

A. Concept , scope approaches of Educational Planning Policy Formulation , Process and Implementation ,
B. Issues and Policy change at National and State level affecting Indian Education with reference to RTE , SSA (UEE) , RMSA , RVSA and other related national and state level Educational Schemes , implementation and monitoring
C. International trends in Educational Research with special reference to Teacher Education
D. Competency based Teacher Education and Innovative programmes for Professional Development of Teachers and Teacher Education

Focus: This Course is employable under the CO1, CO2 and CO3

Outcome:

After completion of this course the researcher will able to:

CO1. To acquaint the researcher with new knowledge pedagogies ad approaches for teaching
CO2. To sensitize towards the need of revamping teacher education to ensure quality
CO3. To understand the need of assessment, standards, and management in Education System
CO4. To develop an understanding of total quality management system in education
CO5. To analyse the policy, programme and recent trades pertaining to Indian Education System.

References:

- Desai D.M. New directions in the Education of Indian teachers Baroda, M.S. University 1971.
- Gupta Arun K. Teacher Education: Current & Prospects New Delhi, Sterling Publications 1984.
- India , Ministry of Education , Report of the Education Commission (1964-66)Education & National development New Delhi publication division 1966.
- Jangira N.K .: Teacher training & teacher effectiveness an experience in teacher , behaviour New Delhi , National Publishing House , 1979.
- NCF 2000, NCF 2005 - NCERT Publication, New Delhi,
- NCFTE - 2009 - NCTE Publication, New Delhi
- UNESCO: Regional office for Education in Asia, Bangkok, Exploring, New dimensions in Teacher Education, Bangkok, UNESCO, and 1976 UNESCO.
- A System approach to teaching & learning procedures a guide for teacher Educators, Paris: UNESCO, 1981 Government of India (1987) Programme of Action , New Delhi : MHRD.

Paper Code-PED 1003: Educational Research Methods &Statistics

Objective:

This course incorporates essential components of Educational Research and advanced methods of Educational Statistics.

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

Unit I: Introduction to Educational Research

Areas of Educational Research—Problems related to Teaching and Learning Process
Research Problem: Selection of Problem, Defining the Problem, Statement of the Problem, Evaluation of the Problem.
Review of related literature: Purpose of the Review, Identification of the Related Literature, Organizing the Related Literature.
Writing of Research Proposal Ethics in Research.

Unit II: Methods of Educational Research

Variables — Dependent, Independent, Intervening, Control.
Hypothesis: characteristics, types, formulation and testing.
Types and steps of Research in Education: Qualitative Research and Quantitative Research
Methods of Quantitative Research: Descriptive survey, Correlation, Causal comparative, Developmental and Experimental Research (Experimental Designs: Pre- Experimental Design, True Experimental Design, Factorial Design, Quasi- Experimental Design).
Methods of Qualitative Research with their designs: Historical, Phenomenology, Ethnography, Grounded theory, and Case study.

Unit III: Sampling Techniques and Research Tools

Sampling: Concept of population and sample, Characteristics of a good sample, Techniques (Probability and Non-probability. sampling techniques), Sampling errors and how to reduce them.
Tools of Educational research: concept, types, forms, preparation (construction), characteristics, validity, reliability, advantages and limitations of following tools: Observation, Interview, Questionnaire, opinionative, Rating Scales, Attitude Scale, check-list.
Standardized tests: Types and characteristics, Criteria for selecting a standardized test, NRT and CRT.

Unit IV: Analysis and Interpretation of Data

Statistical method: Concept of Parameter and Statistics, Levels of Confidence, Degrees of freedom, Standard Error of Mean, one-tailed and two tailed tests I-test (independent and correlated samples), ANOVA: Assumptions, one way and Two way, Correlations: Biserial, Point Biserial, Partial and Multiple, Regression Equation: Regression and Prediction. Chi Square (Test of Equality, Normality, Independence), Sign Test, Mann Whitney U Test, Median Test
Application of MS-Office: Basics of MS-Word, MS-Excel and MS-PowerPoint; Application of these software's for documentation and making reports, Use of SPSS and other statistical software
Plagiarism — Definition, forms, types and consequences. Detection and Prevention of Plagiarism.
Writing of Research Report: Steps involved in writing a research report and characteristics of a good research report

Focus: This Course is employable under the CO1, CO2 and CO3

Outcome:

After completion of this course the researcher will able to:

CO1. Discuss different methodologies and techniques used in research work.
CO2. Explain basic computer skills necessary for the conduct of research.
CO3. Assess the basic function and working of analytical instruments used in research
CO4. Propose the required numerical skills necessary to carry out research.

References:

- Best J. W. (1999). Research in Education, New Delhi: Prentice Hall of India Pvt. Ltd.
- Christensen. (2007). Experimental Methodology. Boston: Allyn & Bacon.
- Flick, Uwe (1996). An Introduction to Qualitative Research. London sage publication 19

COURSES OFFERED

(w.e.f. Session 2020-21)

DEPARTMENT OF ENGLISH

Prerequisite: Comprehension & Communication Skills in English BAGS 0102

Credits:2(1+1) Semester I L-T-P: 1-0-1

Module No.	Content	Teaching Hours
I	War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond B. Fosdick. You and Your English – Spoken English and broken English G.B. Shaw. Reading Comprehension, Vocabulary- Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to Help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations.	06
II	Functional grammar: Articles, Prepositions, Verb, Subject verb Agreement, Transformation, Synthesis, Direct and Indirect Narration. Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing. Interviews: kinds, Importance and process.	07
Practical	Listening Comprehension: Listening to short talks lectures, speeches (scientific, commercial and general in nature). Oral Communication: Phonetics, stress and intonation, Conversation practice. Conversation: rate of speech, clarity of voice, speaking and Listening, politeness &Reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills. Mock Interviews: testing initiative, team spirit, leadership, intellectual ability. Group Discussions.	13

BELH 0001: English Language Skills for Communication-I

Course Objectives: The core objective of this course is to

- equip the learners with the essential knowledge of grammar,
- enable them to write and speak English with considerable accuracy,
- enhance their linguistic competence in comprehending the written and the spoken English and to
- help students acquire the four basic language skills: listening, speaking, reading and writing,

.

Credits: 02 **Semester: I** **L–T–P: 2–1–0**

Module No.	Contents	Teaching Hours
I	**Parts of Speech:** Noun, kinds and usage Pronoun, kinds and usage Adjectives and their degrees **Articles:** Definite and Indefinite articles **Preposition** **Paragraph Writing:** Short paragraphs on the given topics **Vocabulary**: Words Often Confused **Texts:** 'The Eyes are Not Here' by Ruskin Bond 'What We Must Learn from the West' by Narayana Murthy **Reading Comprehension** (Unseen)	**21**
II	**Verb:** Main Verbs – Transitive and intransitive verbs Forms of verbs Auxiliary Verbs and Modal Verbs Linking Verbs Question Tags **Adverb:** Usage and positioning of adverb **Tenses and Usage:** Present, Past and Future **Correction of Errors:** Error correction on the topics covered in module I & II **Reading Comprehension** (Unseen) **Writing Skill:** Describing Pictures **Text:** 'After Twenty Years' by O' Henry	**24**

Recommended Reading:
English Teacher by R.K. Narayan

References:
Course Handbook (Collection of Short Stories, One Act Play & Essays)
English Grammar & Use by Raymond Murphy, IV Edition, Cambridge University Press, UK
Living English Structure by W.S. Allen, Pearson India

Course Outcomes: After the completion of the course students should be able to

1. demonstrate an understanding of correct English usage while expressing themselves in writing,

2. identify common errors of English Language and correct them,
3. evaluate, analyze, understand and discuss relevant information through text and reading comprehension,
4. develop general proficiency in written and spoken English and to
5. get prepared to take the next stage of the course in second semester.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9, PO10, PO11
CO2	PO2, PO9, PO10, PO11
CO3	PO2, PO9, PO10, PO11
CO4	PO2, PO9, PO10, PO11
CO5	PO2, PO9, PO10, PO11

BELH 0002: English Language Skills for Communication-II

Course Objective: The objective of this course is to,

- build up further on the acquired basics of English Language,
- develop students' command over English grammar,
- prioritize the importance of vocabulary, writing skills and comprehension in communication and to
- enrich the essential nuances of English grammar, vocabulary, writing skills and comprehension.

Credits: 02 **Semester: II** **L–T–P: 2–0–0**

Module No.	Contents	Teaching Hours
I	**Sentences and Functional Categories:** Subject, Object, Predicate **Writing Skill**: Developing narratives with the help of key words **Non-Finites: Gerund, infinitives, participle** **Conjunctions** **Simple, Compound and Complex Sentences** **Concord:** Subject-verb Agreement **Voice:** Active & Passive **Text:** 'Water' by C. V. Raman **Reading comprehension (Unseen)**	**16**
II	**Word Formation: Inflection, derivation, blending, compounding and clipping** **Punctuation** **Narration: Direct & Indirect** **Parallelism** **Text**: 'A Brief History of the Future' by Stephen Hawking **Correction of Errors:** Correction of Errors on the topics covered in both modules **Vocabulary: Words that go together** **Writing Skills**: Writing Applications to the university authorities Letters to editors **Reading comprehension (Unseen)** **Text:** 'The Last Leaf' by O' Henry	**14**

Recommended Reading:

Time Machine by H.G. Wells

References:

Course Handbook (Collection of Short Stories, One Act Play & Essays)

English Grammar in Use by Raymond Murphy, IV Edition, Cambridge University Press, UK

Making Sense of English by M. A. Yadugiri, Viva Books Pvt. Ltd., New Delhi

Living English Structure by W.S. Allen, Pearson India

Course Outcomes: After the completion of this course, the students should be able to:

1. demonstrate a use syntactically correct and effective English,
2. identify common errors of English Language and correct them,
3. evaluate, analyze, comprehend and discuss through textual reading and other reading materials,
4. develop an understanding of basics of English Language Learning and to
5. get prepared to take the next stage of the course in the third semester.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9, PO10, PO11
CO2	PO2, PO9, PO10, PO11
CO3	PO2, PO9, PO10, PO11
CO4	PO2, PO9, PO10, PO11
CO5	PO2, PO9, PO10, PO11

BELH 0003: English For Professional Purposes- I

Credit: 02 **Semester: III** **L–T–P: 2-2-4**

Objectives: *The objectives of the course are as follows: (i) To acquaint the students with different facets of communication; (ii) To enhance the students' awareness about the challenges and strategies of effective communication in various socio-cultural domains; (iii) To develop the writing skills of the students with a focus on formal correspondence including e-mail, report writing etc; (iv) To boost the students' interpersonal skills through group presentations, skits and role-playing exercises; (v) To equip the students with advanced skills in English grammar with a focus on the identification and correction of common errors.*

Oral Skills:

Module No.	Contents	Teaching Hours
I	Importance of English in Communication Barriers to Communication Seven 'C' s of Effective Communication Planning Presentations Group Presentations (Jointly drafting a presentation, doing GD & making group-presentations)	10
II	Paragraph Writing: Methods of Paragraph Development; Accuracy, Brevity and Clarity in Writing; Cohesion & Coherence in Paragraph Writing (Through jumbled sentences/paragraph) Coherence Markers as Lexical Bundles E-mail: Formality & Persuasiveness Practice on Short Paragraph Writing, Précis Writing, Summary Writing and Short Report Writing	8
III	Speech/Opinion on a given Topic Situational Role Play Skit Performance	8

Verbal Ability:

Module No.	Contents	Teaching Hours
I	Parts of Speech identification Clausal Analysis: Subject, Object, Predicate and Complement Auxiliary Verbs, Linking Verbs and Modals Tense: Past, Present and Future Reading Comprehension: Level I Subject – Verb Agreement Question Based Learning: Level I	10

II	Determiners Passive and Causative Construction Narration Word Formation Reading Comprehension: Level II Question Based Learning: Level II	**8**
III	Non-finite structure: Gerund, Infinitive, Participial Conjunctions and Connectives Simple, Complex and Compound Sentences Different Degrees of Comparison Reading Comprehension: Level III Question Based Learning: Level III	**8**

STUDY & DRILL MATERIAL/REFERENCE BOOKS

-V.N.Arora. *Improve Your Writing*, OUP
-M. Ashraf Rizvi. *Effective Technical Communication*, TMH
- *Common Errors in English.* Kiran Prakashan

EXPECTED OUTCOME OF THE PRESCRIBED SYLLABUS:

The expected outcomes at the completion of the delivery of the course are as follows:

1. The topics dealing with communication aspects will train the students hands on, by enabling them understand/identify and appreciate the barriers to communication, ways to overcome, process & type of communication etc.
2. The students will be able to understand the needs & requirements of the target audience based on their exposure and knowledge of the subject and will be able to communicate accordingly with certain level of accuracy.
3. The writing skills of the students will be enhanced to such an extent that they could easily prepare and manage materials and strategies of formal correspondence themselves.
4. The students will be equipped with interpersonal skills through group presentations, skits and role-playing exercises. The exercises will help in getting rid of stage-fear, nervousness and hesitation during deliveries of official nature.
5. The students will be able to identify and rectify grammatical errors in written communication.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9, PO10, PO11
CO2	PO2, PO9, PO10, PO11
CO3	PO2, PO9, PO10, PO11
CO4	PO2, PO9, PO10, PO11
CO5	PO2, PO9, PO10, PO11

BELH 0004: English For Professional Purposes- II

Credit: 02 **Semester: IV** **L–T–P: 0–0-4**

OBJECTIVE

The main objective of the course is to provide the students an opportunity to be exposed to different aspects of English language. The course has two major components- firstly, Verbal aptitude with reference to English language and secondly, Drills on oral communication through GD, individual and group presentations and mock-interviews.

Peer-learning is an essential component of the course. The participants will be expected to offer their free, constructive feedback to their counterparts.

Oral Skills:

Module No.	Contents	Teaching Hours
I	Extempore (peer evaluation), debate (on pre-assigned topics), GD: small group discussion, large group discussion (on pre-assigned topics), Cover letter, résumé writing; practice & assignment	10
II	Pre-presentation skills: Preparation- Library research, pooling resources, visual aids, referencing norms, ideal slide, dos and don'ts of presentation Presentation- feedback by the instructor, (body language: posture, spelling convention, smooth transition/turn taking, voice-modulation, proxemics of presentation, handling questions)	8
III	Just a minute (JAM) Pre-interview preparation: know the prospective company, grooming- dressing and attitude, interview etiquettes Peer mock-interview Discussion on most frequently asked questions in interview External (faculty) interview	8

Verbal Ability:

Module No.	Contents	Teaching Hours
I	PoS identification- I FIB on PoS Theme detection Error correction (subject-verb agreement) Error correction (Usage of tense) I & II Error correction (determiners) Quiz- S-V agreement & Tense Quiz- Determiners & PoS Paragraph forming: Jumbled paragraph-I Quiz- Jumbled Paragraph & Theme detection Commonly confused spellings & mispronounced words	10

II	Reading comprehension- summarization; Syn-Ant- I Error correction- Preposition- I & II One word substitution Common errors in Passive and Causative construction Quiz: CCS and MW& OWS Paragraph forming (jumbled paragraphs)- I	**8**
III	Reading comprehension- II Non-finite structure: Gerund, Infinitive, participial FIB on modals Quiz: Gerund, Infinitive, participial & causative and passive Word formation: Inflection, Derivation, Clipping, Compounding, Abbreviation, Acronym Conditionals: theory & Error correction Quiz: Conditionals, Conjunction and connective Error correction (Misplaced & dangling modifiers) Quiz: Word formation Paragraph forming- II Quiz: Term I & Term II Quiz: Term III	**8**

STUDY & DRILL MATERIAL/REFERENCE BOOKS

- A.S. Hornby. *Advanced Learners' Dictionary of Current English,* OUP
- Allegheny college career services: interviewing skills http://sites.allegheny.edu/career/interviewing/
- J.D. O'Connor. *Better English Pronunciation*, CUP
- M. Ashraf Rizvi. *Effective Technical Communication*, TMH.
- Peter Roach. *English Phonetics and Phonology*, CUP

EXPECTED OUTCOME OF THE PRESCRIBED SYLLABUS:

On the completion of this course, the students will be able to do the following things-

1. They will be able to communicate in simple formal situations such as meetings and discussions.
2. They will be able to interact in organizational setting with basic level of appropriateness and fluency.
3. They will develop a sense of language use in relation to place, person and time.
4. They will be able to identify and correct basic level errors in written English.
5. They will develop some sense of common errors in English grammar.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9, PO10, PO11
CO2	PO2, PO9, PO10, PO11
CO3	PO2, PO9, PO10, PO11
CO4	PO2, PO9, PO10, PO11

CO5	PO2, PO9, PO10, PO11

6.

BELH 0005: REMEDIAL ENGLISH

COURSE OBJECTIVE

The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.

Credits: 03 **Semester: I** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**STRUCTURE** **A.1. Tense and Voice:** Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change. **A.2. Reading Comprehension** **i. Analyzing a Text:** Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures & vocabulary; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	14
II	**B.1 Parts of Speech:** Noun: countable and uncountable; Adjective; Adverb; Preposition **B.2. Reading Comprehension** **i. Analyzing a Text** Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures & vocab; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages** (a) Reading a specimen text (b) Contextualising the text (c) Vocabulary and sentence structure	12

III	**C.1. Narration:** Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech. **C.2. Reading Comprehension:** **i. Reading an Essay:** Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure **C. 3.THEME BASED WRITING** Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings and Places, Car Parts , City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey), Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House, Restaurant, Tools, Transportation, Vegetables, Weather	**12**

Text Books:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Robert J. Dixon. *Complete Course in English.* A new revised edition

References:

- Hornby, A.S., *Advanced Learners' Dictionary of Current English,* OUP
- Greenberg, Rondinone & Wiener. *The Advancing Writer Book I,* Harper Collins, College Publishers.
- Liz and Soars. *Headway Pre-Intermediate*. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup & Sons, Delhi 2003

Outcome: After completing the course students will be able to

1. comprehend a text and answer the questions based on it clearly,
2. read a text with proper understanding,
3. express their ideas in writing according to time and tense,
4. enrich their vocabulary in terms of contextual and situational conversation and
5. enhance their listening skills through the video of the text.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9
CO2	PO2, PO9
CO3	PO2, PO9
CO4	PO2, PO9

CO5	PO2, PO9

BELH 0005: REMEDIAL ENGLISH

COURSE OBJECTIVE

The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.

L-T-P: 3-0-0 **Semester: I** **Credits: 03**

Module No.	Content	Teaching Hours
I	**APPLIED GRAMMAR** **A.1. i. Tense and Voice:** Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change. **ii. Parts of Speech:** Noun: countable and uncountable; Pronoun: Personal Pronoun; Adjective; Adverb; Preposition **A.2. Reading Comprehension** **i. Analyzing a Text:** Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures & vocabulary; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	**20**
II	**B.1. Reading Comprehension** **i. Analyzing a Text** Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures & vocab; Analysis of the content of the text: interactive session. **ii. Reading an Essay:** Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers. **iii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure **B.2. Narration:** Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech.	**25**

	B.3.THEME BASED WRITING Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings and Places, Car Parts , City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey), Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House, Restaurant, Tools, Transportation, Vegetables, Weather	

Text Books:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Robert J. Dixon. *Complete Course in English.* A new revised edition

References:

- Hornby, A.S., *Advanced Learners' Dictionary of Current English,* OUP
- Greenberg, Rondinone & Wiener. *The Advancing Writer Book I,* Harper Collins, College Publishers.
- Liz and Soars. *Headway Pre-Intermediate*. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup & Sons, Delhi 2003

COURSE OUTCOMES: After completing the course students will be able to:

CO1- comprehend a text and answer the questions based on it clearly
CO2- express their ideas in writing according to time and tense
CO3- enrich their vocabulary in terms of contextual and situational conversation
CO4- enhance their listening skills through the video of the text

Focus: This course focuses on employability and skill development, aligned with all the COs.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO2, PSO3
CO2	PO1, PO2, PO4/PSO1, PSO3
CO3	PO6, PO7,PO8/PSO2, PSO3
CO4	PO3, PO6,PO7/PSO1

Ethics & Values: BELH0006/L: T: P
2 0 0

Course Description

This course is designed to enhance the student's understanding of self and society. Through an approach based on logic and rationality, the course encourages them to critically analyze the moral issues of the age we live in. The aim is to equip students with an enlightened mindset that will enable them to become valuable members of the society, both individually and professionally.

Course Objectives

- To enhance the student's ability to understand ethical problems of social and professional life.
- To help them develop the skillset required for ethical decision making
- Develop an attitude of commitment to build a better society using their knowledge and skills.

Course Content

Module I: Ethics and Moral Reasoning

Unit 1: The Foundations of Ethics

1. Introduction to Ethics: Definition, method, nature of moral judgement
2. Understanding oneself: A practical exercise
3. Moral Psychology and Ethical Dilemmas
4. Case Study-The Runaway Trolley Thought Experiment
5. Implications of the case

Unit 2 : Professional Ethics

1. Technology and Society: Business Ethics, Corporate Social responsibility
2. Engineering Ethics: Innovation, Technology and Sustainable development
3. Case Study: The Space Shuttle Challenger Disaster
4. Inspirational lives: APJ Abdul Kalam, Sachin Tendulkar, Steve Jobs, Nelson Mandela

Module II: Ethical Systems and Approaches

Unit 1: Ethics and Indian thought

1. Ethics in Ancient India: The Ashrama system, Varnas, Gurukul
2. Vedic Systems: Yoga, Sankhya, Vedanta, Gita
3. Non-Vedic systems: Carvaka, Buddhism, Jainism
4. Bhakti Movement

Unit 2: Ethics and Classical Western Thought

1. Aristotle's Virtue Ethics
2. Utilitarianism-Bentham
3. Utilitarianism-Mill

4 .Case Study: Life Boat case
5. Immanuel Kant and Deontological Ethics

Unit 3 : Religion and Ethics

1. Concept of God, Proofs for the existence of God
2. Problem of Good and Evil
3. Theism vs Atheism
4. Humanism

Module III: Ethics and the Contemporary World

Unit 1: Ethics and Contemporary Indian thinkers

1. Vivekananda
2. Gandhi
3. Tagore
4. Radhakrishnan
5. Amartya Sen

Unit 2: Ethics and Modern Western Thought

1. Libertarianism- Nozick
2. Egalitarianism-Rawls
3. Different Socio Political Systems Welfare State, Free-market etc.
4. Case Study: Affirmative Action

References:

1) **Sandel J. Michael, Justice: What's Right Thing To Do? , Penguin Press.**
2) **Laura P. Hartman: Perspectives In Business Ethics, Part One: Chapter One, McGraw Hill Publication**
3) **https://www.google.co.in/#q=references+for+Kantianism%2C+Libertarianism+and+Virtue+Theory**
4) **http://www.iep.utm.edu/libertar/**
5) **M. Hiriyanna. "Outlines of Indian Philosophy". Motilal Banarsidas.**
6) **Lal, B. K. Contemporary Indian Philosophy, Motilal Banarsidass, Delhi, 1992.**
7) **http://www.youtube.com/watch?v=kBdfcR-8hEYThe International Encyclopedia of Ethics: https://onlinelibrary.wiley.com/doi/book/10.1002/9781444367072**
8) **Rutledge Companion to Ethics: https://The_Routledge_Companion_to_Ethics_@nadal.pdf**
9) **Encyclopedia of Philosophy of Religion: https://www.iep.utm.edu/religion/**
10) **Engineering Ethics: https://www.youtube.com/watch?v=n9A8-FjhArE&list=PL746AE3CCB29B64B8**

BELH 0007: English Language Skills - I

Course Objectives: Keeping in mind the diverse set of students (as far as their mother tongues are concerned) in the undergraduate programmes of the University, this course aims to

- help students acquire the four basic language skills: listening, speaking, reading and writing,
- introduce fundamentals of English grammar for its proper usage,
- facilitate the learners to think logically, evaluate judiciously and express themselves effectively in spoken as well as written English,
- enhance appropriate vocabulary, and to
- enable them to attain standard Indian English pronunciation as well as provide them practice of speaking in stress free environment.

Credits: 03 **Semester: I** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Grammar**: Parts of Speech: Noun, Pronoun, Adjective, Adverb, Verb Sentence **Vocabulary**: Word Formation using prefixes & suffixes **Reading:** Study of Text: "The Eyes are not Here" by Ruskin Bond; **Speaking**: Describing self, persons, places & objects **Vocabulary**: Words often confused **Writing:** Developing a story from given clues	21
II	**Grammar**: Tense; Prepositions, Articles, Subject – Verb Agreement **Communication**: What is communication? Process of communication; Types and barriers of Communication **Error corrections**: Related to the grammar topics covered in module I & II. **Vocabulary**: Synonyms & Antonyms **Study of Text**: "After Twenty Years" by O' Henry. **Speaking:** Role Play and Small Talk**,** Speaking on need based topics like talking about habits, daily routine, likes and dislikes.	24

Prescribed Text: *An Anthology of Short stories,* Ed. RP Singh, Oxford University Press, New Delhi

References:

Wren & Martin**,** *High School English Grammar and Composition***,** S.Chand & Co. Ltd., New Delhi.
Allen, W., *Living English Structure*, Pearson Education, New Delhi.
Collins English Dictionary, Harper Collins Publication Ltd.

Longman Dictionary of Contemporary English, Pearson Longman, England.
Murphy, Raymond, *Intermediate English Grammar,* Cambridge University Press.
Norman Lewis, *Word Power Made Easy*, Goyal Publications & Distributers, Delhi.
Mohan, Krishan & N.P. Singh, *Speaking English Effectively*, Macmillan India Ltd., New Delhi.
Audio-Visual Material: Material available in the language Lab.

Course Outcomes: After the completion of the course, the participants should be able to

1. speak and express themselves effectively and confidently in groups and communicate in real life situations,
2. read a text to comprehend, analyze and evaluate it effectively in both written as well as spoken English,
3. enrich their vocabulary and apply it appropriately in the required context,
4. state their view point with confidently, and to
5. understand good communication strategies.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO6, PO7, PO9
CO2	PO6, PO7, PO9
CO3	PO6, PO7, PO9
CO4	PO6, PO7, PO9
CO5	PO6, PO7, PO9

BELH 0008: English Language Skills-II

Course Objectives: The objectives of this course are to:

- enhance students' proficiency in the four basic language skills: listening, peaking reading and writing,
- enable them to classify, form and construct a variety of sentences as per the requirement of context,
- make students understand basic grammar items for their proper usage,
- facilitate the students to think critically, organize their thoughts systematically, assess their observation prudently and present themselves effectively in spoken as well as written English,
- increase vocabulary and its usage in speaking and writing, and to
- familiarize the learners with nuances of writing and enable them to write a good piece using correct format, language and tone.

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

Module No.	Content	Teaching Hours
I	**Grammar**: Active & Passive Voice Question Tags Modal Auxiliaries **Vocabulary**: One Word Substitution, Homonyms & Homophones **Writing:** Description of Technical Objects Paragraph writing – Principles & Development; writing a paragraph on a given topic **Study of Text**: "Science and Human Life" by JBS Haldane **Speaking:** Group Discussion; Words commonly mispronounced	**18**
II	**Grammar**: Conjunctions, Conditionals, Error Correction **r**elated to the grammar topics covered in modules I & II **Listening**: Importance of listening, Listening & Hearing, Active & Passive Listening and Barriers **Vocabulary**: Technical Vocabulary, Situational Vocabulary, Phrasal Verbs **Writing**: Formal Applications & Letter to Editor **Study of Text**: "The Heritage of India" by A.L. Basham **Speaking:** Power Point Presentation	**18**

Prescribed Text: *An Anthology of English Essay,* Ed. RP Singh, Oxford University Press, New Delhi

References:

Wren & Martin**,** *High School English Grammar and Composition***,** S.Chand & Co. Ltd., New Delhi.
Allen, W., *Living English Structure*, Pearson Education, New Delhi
Collins English Dictionary, Harper Collins Publication Ltd.
Longman Dictionary of Contemporary English, Pearson Longman, England.
Murphy, Raymond, *Intermediate English Grammar,* Cambridge University Press.
Norman Lewis, *Word Power Made Easy*, Goyal Publications & Distributers, Delhi.

Mohan, Krishan & N.P. Singh, *Speaking English Effectively*, Macmillan India Ltd., New Delhi.
Audio-Visual Material: Material available in the language Lab.
Course Outcomes: After the completion of this course, the students should be able to

1. acquire correct listening and speaking strategies as well as appropriate reading and writing skills,
2. participate in formal or informal discussions or conversations using appropriate vocabulary and expression,
3. convey their thoughts and views properly while writing and speaking,
4. evaluate, analyze, comprehend and discuss a text and other reading material, and to
5. acquire general proficiency in written and spoken English.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO6, PO7, PO9
CO2	PO6, PO7, PO9
CO3	PO6, PO7, PO9
CO4	PO6, PO7, PO9
CO5	PO6, PO7, PO9

BELH 0010: GENERAL ENGLISH I

Course Objectives

The course helps students understand the basic grammatical structures of English Language and communicate in English. Its focus is on increasing students'over-all competence in the language.

Credits: 06 **Semester: I** **L–T–P: 5–2-0**

Module No.	Contents	Teaching Hours
I	**Grammar** • Sentence: statements, questions, imperatives, exclamatory • Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb • Tense • Subject verb agreement • Passives **Reading** *God Sees the Truth but Waits*- Leo Tolstoy **Vocabulary** Antonyms and Synonyms **Speaking** • Basics of Communication: Forms, Types, Flow, Levels • Role Play • Extempore	**30**
II	**Grammar** • Parts of Speech: Preposition, Conjunction • Types of Sentences: Simple, Compound and Complex • Gerund, Participle, Infinitives • Narration **Writing:** Paragraph Writing – essential elements of unity, order, coherence& completeness. Writing paragraph on given topics. **Reading** *PanchParmeshwar* (English Translation)- MunshiPrem Chand. **Vocabulary** One word substitution **Speaking:** Group Discussion.	30

Suggested Readings:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Leech, Geoffrey &Svartvik, Jan: *A Communicative Grammar of English*.London: Longman, 2003.
- Swan, Michael. *Practical English Usage.* OUP, 2016.
- Nesfield, J.C. *English Grammar, Composition and Usage*. Macmillan Publishers India Pvt. Ltd, 2019.
- Hornby, A.S., *Advanced Learners' Dictionary of Current English,* OUP.
- Jones, Daniel. *Cambridge English Pronouncing Dictionary.* London: Cambridge University Press, 2006.

CourseOutcomes: After completing the course students should be able to

1. read a text for correct comprehension,
2. enrich their vocabulary,
3. carry interactions in groups and
4. express their ideas in writing using correct grammar.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes(Cos) with Program Outcomes(Pos)

COs	Pos
CO1	PO1, PO2, PO3, PO7
CO2	PO2, PO3, PO7
CO3	PO1, PO2, PO3, PO7
CO4	PO1, PO2, PO3, PO7

BELH 0011: General English II

Course Objectives

- *To help students understand and communicate in English as used in day to day activities and in legal domain*
- *To help students increase their competence in legal English*
- *To help students understand the language used in legal domain*

Credits: 06 **Semester: II** **L–T–P: 5–2-0**

Module No.	Contents	Teaching Hours
I	**Spotting Errors- I** Punctuation Vocabulary: spellings and Derivation of Latinate Words **Reading:** On His Conviction for Sedition: A selection from Gandhi's closing statement to the judge on March 23, 1922 **Movie:** *Death at a Funeral* - Discourse Analysis by students	**20**
II	**History of Legal English** **Presentation Strategies** **Individual/Group Presentations** Presentation of Mock Proceeding at Moot court **Spotting Errors- II** Syntax: Analysis of Simple, Complex and Compound Sentence **Reading:** Act-IV, Scene I, "Merchant of Venice": A Court of Justice by William Shakespeare, Discourse analysis by students. **Recommended Movie: "**Merchant of Venice" (2004) directed by Michael Radford	20
III	**Drafting Legal Documents** FIR, Drafting- mail, petition, Bail Petition, Arguments, Counter Arguments, Affidavit etc. **Oral Presentations** (Arguments and Submissions) **Selected Reading:** "Of Judicature" – Francis Bacon	20

Books Recommended:

- Peter Roach. *English Phonetics and Phonology*. UK: CUP, 2010.
- Cochrane, Michael. *Legal English*. Paris: Cujas, 1987.
- Prasad, Anirudh. *Outlines of Legal Language in India*. Allahabad: Central Law Publications, 2007.

Desired Reading:

- Perry Mason series of detective stories by Erle Stanley Gardner.
- Agatha Christie
- Sherlock Homes

Course Outcomes

After successful completion of the course, students should be able to

1. write grammatically correct meaningful sentences with proper punctuation
2. present their ideas in English
3. draft FIR and bail petitions
4. prepare affidavits and

5. present case in correct English.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO1, PO2, PO3, PO7
CO2	PO1, PO2, PO3, PO7
CO3	PO2, PO3, PO7
CO4	PO2, PO3, PO7
CO5	PO1, PO2, PO3, PO7

BELH 0012: INTRODUCTION TO GENDER & WOMEN'S STUDIES

OBJECTIVES: An introductory course designed to introduce students to a variety of issues and disciplinary approaches to the study of women and gender. Classes will use audio-visual methods with oral presentations by students. Emphasis is given to the English language skills for oral communication and writing. Compulsory attendance. Limited enrolment for supervised learning.

EXPANDED DESCRIPTION: The question of gender is often a vexing one that has been important in shaping human experience and culture. We will explore how gender intersects with class, ethnicity, religion, age and other categories of experience. This course will focus primarily on gender and women's issues in the modern world. In addition to assigned readings from a range of texts, we will also attempt to examine representations of women and their condition in film and other media.

Themes: With a focus on issues of gender in domestic and workplace situations, the course will use the reading selections and multimedia materials to address a wide range of topical categories and themes, which will also be the base of students' Oral/Group Presentations:

Credits: 2 **Semester: II** **L-T-P: 2-0-0**

Module	Content	Teaching Hours
I	**Introduction** Becoming a Man or Woman: Emotions, Love, Beauty and the Media Women, Men & Sexuality: Gender & Human Bodies Modernity and Power: Institutions that Shape Our Lives Violence against Women: Domestic & Work Spaces Women and Violence: War and Terrorism	**12**
II	Health & Reproductive Freedom: Mothering and Parenting Differences among Us: Ageism, Racism and Prejudice **Review** Changing Our World: Culture, Society & Practice of Gender Sensitization Oral Presentations by Students	**18**

Recommended Reading:All materials will be available via email or online LMS (there are no course textbooks to purchase). Students will require access tothe internet and a computer.

Audio-Visual Material:Audio recordings will be made available via CDs and online.

References: Study-pack derived from *Women: images and realities. A multicultural anthology*. 4th edition. Edited by Amy Kesselman, Lily D. McNair, Nancy Schniedewind. McGraw-Hill, 2007.

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

CO1- Identify important terms and concepts in the field of gender studies
CO2- Discuss the significance of important work done in this field
CO3- Discuss how different factors like age, ethnicity, race and culture impact human experiences
CO4- Discuss how women's studies and gender sensitization have led to revisions of cultural assumptions and practices regarding women
CO5- Relate gender concepts to our lived experiences
CO6- Be able to develop an oral presentation on a proposed project in some area of gender sensitization

Value Addition: Students will be able to connect, write and speak with confidence and clarity about their own responses to the selected readings and about gender and women's issues from multiple perspectives.

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

COs	**POs/ PSOs**
CO1	PO1, PO4, PO7, PO8 /PSO1, PSO2
CO2	PO2, po3, PO4, PO5, PO7, PO8 /PSO1
CO3	PO2, PO8 /PSO1, PSO2
CO4	PO1, PO2, PO8 /PSO2
CO5	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO6	PO2, PO5, PO7, /PSO1, PSO2

BELH 0801: English Language Lab-I

Course Objectives: The objectives of the course,' Language Lab I,' are to

- sensitize the participants towards the need of developing communication skills in technical world and encourage them to make conscious efforts to improve them,
- provide students practice of listening to English language for comprehending, grasping and following standard Indian English,
- assist them to attain correct pronunciation and intonation in their language,
- enable them to think critically and form their opinion along with presenting it confidently, and to
- create a platform for the learners to practice speaking English language in various social and professional settings.

Credit: 01 **Semester: I** **L–T–P: 0–0–2**

Module No.	Contents	Teaching Hours
I	**Audio Visual Material for Listening and Speaking** The Power of English: How English became a global language Entry level recording by students Sounds of English (Sky Pronunciation) Listening Comprehension: Internet Addiction Video Clips on Spoken English 'Ancient India's Engineering Skills': A documentary **Speaking Activities:** Introduction of the Students Practicing pronunciation (with the help of dictionary) Situational Role Plays Discussion on the issues related to listening exercises Discussion on the India's Skills	14
II	**Audio Visual Material for Listening and Speaking** Listening Comprehension: Indra Nooyi Interview of Ratan Tata & Narayan Murthy 'The thrilling potential of 6th sense technology' (TED) One Way Ticket to Mars Mission Short Fiction: "The Necklace" Role Play Exit level recording **Speaking Activities** Activity: Describe your role model Role Plays and Discussion on Entrepreneurship Describing process Discussion related to audio-visual activities Picture Discussion	8

Audio-Visual Material:
itell: Study Material of 'Orell' Digital Language Lab.

References:
Norman Lewis, *Word Power Made Easy*, Goyal Publications & Distributers, Delhi.
Mohan, Krishan & N.P. Singh, *Speaking English Effectively*, Macmillan India Ltd., New Delhi
Cambridge English Pronouncing Dictionary by Daniel Jones

Course Outcomes: After the completion of the course students should be able to

1. exhibit an understanding of listening and speaking English correctly,
2. acquire proper pronunciation with fluency and intonation,
3. enrich their vocabulary and expression in spoken English,
4. analyse social issues critically and present them effectively, and to
5. enhance their speaking skills, gain confidence and overcome hesitation while conversing in English.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9, PO10, PO11
CO2	PO2, PO9, PO10, PO11
CO3	PO2, PO9, PO10, PO11
CO4	PO2, PO9, PO10, PO11
CO5	PO2, PO9, PO10, PO11

BELH 0802: English Language Lab II

Course Objectives: The objectives of this course are to

- sharpen the oral skills of the learners through more advanced practice of listening and speaking skills than those mentioned in Language Lab I syllabus,
- give them an opportunity to form opinions and develop analyzing capabilities, as well as present the same orally,
- familiarize them with dynamics of group interactions as well as individual presentations,
- provide them with practice of speaking in various social and professional situations, and
- hone their overall communicative skills in English.

Credit: 01 **Semester: II** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**Audio Visual Material for Listening and Speaking:** Speech by R. Madhavan at Harvard University: India in 2030 Debates: Tips & Samples 'One Crime History': Animated video Listening Comprehension: Sundar Pichai Situational Dialogues 'India on four wheels': A BBC documentary 'Extempore: Tips & Demo(Video) **Speaking Activities:** Discussion on India in 2030 Debate: A Class Activity Newspaper reading and discussion Extempore Discussion on problems of India & possible solutions Role Plays	14
II	**Audio Visual Material for Listening and Speaking:** Group Discussion' – Dos and Don'ts A Police Chief with a Difference' – TED Talk by Kiran Bedi Public Speaking Short Fiction: 'An Astrologer's Day' R K Narayan Exit level recording by students **Speaking Activities:** Group Discussion: A Class Activity Discussions on gender discrimination Presentations A Class Activity: Meet a Celebrity	14

Audio-Visual Material:

itell: Study Material of 'Orell' Digital Language Lab.

References:

Norman Lewis, *Word Power Made Easy*, Goyal Publications & Distributers, Delhi.
Mohan, Krishan & N.P. Singh, *Speaking English Effectively*, Macmillan India Ltd., New Delhi
Cambridge English Pronouncing Dictionary by Daniel Jones

Course Outcomes:

After the completion of the course students should be able to

1. listen, understand and analyse a variety of speeches, documentaries and interviews,
2. express themselves with correct pronunciation and fluency,
3. use appropriate vocabulary, body language and group dynamics,
4. participate in discussions on social and professional issues, and
5. prepare themselves to take the next stage of the course in the third semester.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9, PO10, PO11
CO2	PO2, PO9, PO10, PO11
CO3	PO2, PO9, PO10, PO11
CO4	PO2, PO9, PO10, PO11
CO5	PO2, PO9, PO10, PO11

BELH 0803: ENGLISH IN PRACTICE

COURSE OBJECTIVE

'English in Practice I' focuses on communication activities in functional and situational contexts. It encourages students to speak with fluency and accuracy as well as develop the four skills of reading, writing, listening and speaking. The classes will be theme based to provide practice in a meaningful context which can be extended outside the classroom.

Credits: 02 **Semester II** **L–T–P: 0–0–4**

Module No.	Content	Teaching Hours
I	A. **Activities based on Life of Pi:** Introduction of the movie and the novel; Showing the video clips from the movie to the students; reading of parts of the novel; Interactions on some aspects of the movie and the novel; Role play based on the different scenes of the movie. B. **Mechanics of Writing:** Memo writing, Email Writing, Business Letter: Application and cover letter for resume. C. **Sky Pronunciation:** Practice of pronunciation.	22
II	A. **Applications of English Grammar:** Modal Verbs; Auxiliary and Linking Verbs; Transitive and Intransitive Verbs. B. **Vocabulary:** Words from the business register and of day to day to usage. Vocabulary of character description, History, Homes and Houses (A list of words can be provided as a supplement) C. **Fine Tuning Listening and Speaking Skills with Audio Visual Aids:** 'Freedom is not Free' by Shiv Khera: showing the video followed by a discussion, asking students questions based on the speech; Video of News from BBC and Times Now: Asking the students to listen to the news and try to speak like the anchor in front of the class.	18
III	A. **Role Play:** Performances based on *Life of Pi* or any other text read/ prepared by a group of students. B. **Group Discussion:** Introduction of group discussion; Allocation of topics for Group Discussion. C. **Movie Review:** Showing movie review video; reading movie review from news papers.	18

References:

Websites:

www.bbc.co.uk

https://www.youtube.com/user/timesnowonline

Text Books to be followed:

Mani .P & Deepthi. S, *English for Teaching,* CUP

Regional Institute of English, *'English for Engineers'*, Bangalore, Foundation Books Pvt. Ltd.

References:

Lewis, Norman. Word Power Made Easy. Revised and second edition. Goyal Publisher, 2014. New Delhi.

Hornby, A.S., *An Advanced Learners' Dictionary of Current English*, OUP.

Murphy, Raymond, *Intermediate English Grammar,* Cambridge University Press.

Material:

Audio-Video Material available in the language Lab and texts such as Newspapers etc

Outcome: At the end of the course, the students will be able to

- develop reading habit and improve their writing skills,
- listen and understand English news and documentaries,
- communicate ideas within a group,
- understand and communicate with Standard English speakers and
- narrate/describe an event in English.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9
CO2	PO2, PO9
CO3	PO2, PO9
CO4	PO2, PO9
CO5	PO2, PO9

BELH 0804: EFFECTIVE COMMUNICATION & PERSONALITY DEVELOPMENT

COURSE OBJECTIVE:

The course has been designed to help students know their inherent strengths & weaknesses, to build confidence and belief in what they are doing and to prepare them to face the world at large successfully.

Credits: 02 **Semester III** **L–T–P: 0–0–4**

Module No.	Content	Teaching Hours
I	**Introduction:** Introducing Soft Skills and Hard Skills. Important Soft Skills: Leadership, Team Spirit, Motivation, Attitude, Self Development, Self-Esteem, Interpersonal & Behavioral Skills., Positive work ethics, Cooperation & coordination, Awareness. **Effective Communication:** Important factors in Communication, Overcoming the tentative Barriers, Purpose of Communication, Describing common people, objects, daily incidents, interpreting pictures, documentaries & cartoons, News Discussion.	20
II	**Time Management:** What is time management? Importance of Time in the professional world, challenges, Identifying priorities, prioritizing priorities, multitasking ,Time management and Pressure handling, **Conversations:** Breaking the ice, Face-to-face conversation, Telephonic Conversation, role plays (situational). **Problem Solving:** Defining & analyzing a problem, generating solutions, **c**hoosing the best solution & developing action plan	20
III	**The Art of Presentation:** Meaning and importance of presentation, Analyzing Different types of Presentation, How to make an effective presentation, Body Language, Understanding Kinesics, Proxemics, Gestures, Eye contact in a presentation. Extemporaneous Presentation. Analyzing the importance of presentation strategies in our life through the study of various case studies. **Group Discussions,** Concepts of a G.D.: Confidence, Structured & Unstructured G.D, Preparing for GD, Effective G.D Participation, How to give a Good Impact in a G.D., useful phrases, range of topics	20

References:

- Poyatos, F. *Non Verbal Communication Across Disciplines*, University of New Brunswick.
- Rao, M.S. & Ramana, P.S.V., *Soft Skills for Better Employability*. ICFAI University Press.
- Cook, S. *The Effective Manager(e-book).* IT Governance Publishing
- Bhatnagar, Nitin & Mamta Bhatnagar, *Effective Communication and Soift Skills: Strategies for Success.* New Delhi, Pearson (Dorling Kindersley, India Ltd.)
- Mohan, Krishan & NP Singh, *Speaking English Effectively*, New Delhi: Macmillan Publishers India Ltd.
- Rizvi, Ashraf, M. *Effective Technical Communication.* New Delhi: Tata McGraw Hill.

Outcome: At the end of the course, the participant will be able to

1. listen and understand English news and documentaries,
2. understand and communicate with Standard English speakers,
3. make various presentations with different expression,
4. narrate/describe an event in English and
5. participate confidently and efficiently in various types of group discussions.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9
CO2	PO2, PO9
CO3	PO2, PO9
CO4	PO2, PO9
CO5	PO2, PO9

BELH 0805: PROFESSIONAL COMMUNICATION & BEHAVIOURAL GROOMING

COURSE OBJECTIVE

The course, being the last input in the series given to the student, is more placement-oriented than its predecessors. It aims to inculcate the applications of English language in the students. It further explores the ways to improve the ability of the students to present themselves in front of any group or an individual confidently. The syllabus also tries to enhance the competitive abilities of the students by providing them exposure to the content and exercises practiced in such exams.

Credits: 02 **Semester IV** **L–T–P: 0–0–4**

Module No.	Content	Teaching Hours
I	**Application of English Language-** Syntax: Correction in different parts of speech, syntactical errors in the order of words in a sentence, mistakes in conditionals and tenses; Jumbled Sentences; Jumbled Paragraphs; Phrasal Verbs; Verbal Reasoning. **Classroom Activities:** ✓ Practice sheets will be provided on select topics, and the same will be discussed with the students once they have attempted it. ✓ Students will be given topics for PPT presentations in groups and they will be evaluated on the parameters explained to them very clearly. **Introduction of Drama –** Introduction of the drama Julius Caesar, Showing the video, reading of some dialogues by the students. **Classroom Activities:** ✓ The students will be given assignments to perform certain scenes from the play. They will be given around a month for preparing. They may take the guidance of the teacher for the same. Ideally, they should give presentation, scene-wise so that it could be more comprehensive.	**24**
II	**Reading & Writing Skills- a)** Reading comprehension, letter writing: Inquiries and their replies, placing and cancelling orders, adjustment letters, accepting and rejecting offers, resume & CV writing, business report writing, application, Précis writing, E-mail writing **Vocabulary-** Extension methods, synonyms, antonyms, one word substitution, words often confused idioms & phrases.	**18**
III	**Performance of Drama by Students:** Presentation of different scenes of Julius Caesar by William Shakespeare, by students. The teacher will evaluate the students on the parameters pre-explained. **Group Strategies & Group Discussion:** GD vs Debate, Practice of Abstract topics. **Interviews:** What is an interview? Types of Interviews, Preparing for Interviews, Drills required for Interviews, potential interview questions, Mock Interview activities.	**18**

- Turner, W. *Julius Caesar* , S. Chand & Co. New Delhi,2008.
- Martin, H. & Waren, **P. C.** *English Grammar & Composition.* S. Chand & Co. New Delhi,2006
- Sharma, S.D., *Text of professional Communication Skills and ESP for Engineers and Professionals,* Sarup & Sons, Delhi
- Hornby,A.S.,. *Advanced Learners' Dictionary of Current English,* OUP
- Murphy. Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Rizvi, Ashraf, M. *Effective Technical Communication.* New Delhi: Tata McGraw Hill

Course Outcomes: At the end of the course, the participant will be able to

1. handle the challenges of competitive environment,
2. develop a reading habit and improve their writing skills,
3. listen and understand English news and documentaries,
4. understand and communicate with Standard English speakers and
5. narrate/describe an event in English.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO2, PO9
CO2	PO2, PO9
CO3	PO2, PO9
CO4	PO2, PO9
CO5	PO2, PO9

BELH5001: TECHNICAL WRITING

Course Objectives: To make the students understand the concepts ofvarious modes of written communication used to disseminate information within and outside an organization.

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	Forms & features of communication factors facilitating communication-communication channels, Flow of communication, Language skills-LSRW, Barriers to communication, Words and Phrases, Sentences and Paragraphs, Art of condensation reading comprehension, Analyzing audience, Organizing contents, Preparing an outline, Visual aids paragraph writing characteristics and methods Technical reports, Importance, Preparatory steps and Structure letters, Memos and E-mails- structure, Principles, Types.	20
II	Technical proposals- Definition, Types, Structure and Style. Journal articles/ Research papers- Nature, Significance and essentials. Job Application- Resume, Curriculum Vitae and Cover letter. Interviews-Types, Preparation, Success and Failure Factors. Agenda and minutes of a meeting. Note making & summarizingDissertation and Thesis- Definition, Characteristics Style and Presentation. Preparing List of References and Bibliography: Referencing Conventions	20

Text Books:

- R. Meenakshi and S. Sharma, Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2015.

Reference Books:

- M. A. Rizvi, Effective Technical Communication, New Delhi, Tata McGraw Hill, 2005.
- R. C. Sharma and K. Mohan, Business Correspondence and Report Writing, Tata McGraw Hill, New Delhi, 2002.

Learning Outcomes:

After studying these topics, the student will be able to

1. Understand communication features
2. Learn writing skills to write technical reports, formal messages and letters
3. Know the writing of technical proposals, research papers, dissertation reports etc.
4. Make curriculum vitae, resume and agenda and minutes of a meeting

Focus: This course focuses on employability and skill development, aligned with all the COs.

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

COs	Pos
CO1	PO7, PO8, PO9, PO10/ PSO4
CO2	PO7, PO8, PO9, PO10/ PSO4
CO3	PO7, PO8, PO9, PO10/ PSO4
CO4	PO7, PO8, PO9, PO10

BELO 0001: INTRODUCTION TO BHAGAVAD GITA

Objective: *This course aims to introduce the five main topics of Bhagavad Gita i.e. Living Entity (Atma), Bhagwan (Paramatma), Time (Kala), Actions (Karma), Mother Nature (Prakriti). Different forms of Yoga & the topmost Yoga System are also covered. At the conclusion, practical applications of Bhagavad Gita in our daily life will be discussed.*

Credits: 02 **L-T-P: 2-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Bhagavad Gita:** Humans Vs. Animals; Three ways of gaining knowledge; Importance of Bhagavad Gita amongst the vedic literatures; Five main topics of Bhagavad Gita. **Living entity (*atma*) & Bhagvan (*paramatma*):** Knowledge of soul and scientific proof of soul's existence; Difference between soul and supreme soul. **God-Demigods:** Who is God? Why Different Gods; Different Scriptures; Essence of all the major religious scriptures. **Time (*Kala*), Actions (*Karma*), Mother Nature (*Prakriti*):** 5 Gross elements; Gross Body and Subtle Body; Laws of Karma & Reincarnation; 8,400,000 species of life; Six transformations in body; Evolution of consciousness; Three modes of material nature: Goodness (*Satva-gun*), Passion (*Rajo-gun*), and Ignorance (*Tamo-gun*), Art of dying, Practical techniques for becoming free from Karma and Reincarnation,	15
II	**Different forms of Yoga and the Topmost Yoga system:** What is Yoga; Fruitive activities (*Karma-Kanda*); Karma Yoga (*Sakaam and Nishkaam*), *Gyan* Yoga, *Ashtanga* Yoga, *Dhyan* Yoga, *Buddhi* Yoga, and *Bhakti* Yoga (9 fold path); The culmination of all yoga systems; Yoga Ladder; The real problems of life (Birth, disease, old age, and death); Three fold miseries (*Adhyatmika, Adhibhautika, & Adhidaivika*). **Practical Application of Bhagavad Gita in our Daily Life:** Krishna Consciousness; Deity worship; Offering *bhoga*; Eating prasadam, Hearing glories of the Lord from holy scriptures; Chanting the holy names of the Lord; Life duration and process of attaining Love of Godhead in different ages (*Satyuga, Treta Yuga, Dwaparyuga, and Kaliyuga*), 6 problems of modern men, *Dharma, Mantra*, Vegetarianism. **Conclusion:** Students' self assessment of *Bhagavad Gita*.	15

Reference Books/ Text Books / Case Studies: A. C. Bhaktivedanta Swami: (1) *Bhagavad Gita As IT IS* (Text Book); (2) *Bhagwat Purana;*(3) *Isopnisad;* Devadatt Patnaik: *My Gita*

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

- Exhibit a significant subject knowledge about the *Bhagvad Gita* and Indian philosophy.
- Understand the meaning of *karma, dharma, mantra, yoga*, reincarnation, and vegetarianism.
- Understand five main topics of Bhagavad Gita i.e. *Atma* (Living Entity), *Paramatma* (Bhagwan), *Kala* (Time), *Karma* (Actions), & *Prakriti* (Mother Nature).
- Apply the knowledge of *Bhagavad Gita* to live stress free and happy life.
- Display and articulate a substantial understanding of ethics in leadership and other situations.
- Communicate original thinking and ideas about humanity, the environment and issues of sustaining a global society with confidence, as individuals and as part of a team.
- **Value Added Component**: Develop a passion for lifelong learning in an atmosphere of academic harmony, mutual respect, cooperative endeavour and receptivity towards positive thinking.

BELO 0002: Glimpses of Indian Literature: Classical to Colonial

Introduction: This course on Indian Literature (from Classical to Colonial Period) would help the students in getting a deeper insight of Indian Literature (from Classical to Colonial Period). Various activities and exercises based on the prescribed texts like, conversation, discussion, mini presentations, and detailed reading will provide the students enough of opportunities & exposure to sharpen their English language skills.

Objectives:

- The course aims to create a critical awareness of the Indian Classics.
- The course intends to give a glimpse of the canonical texts in Bhasha Literatures.

Credit: 04 **Semester: III** **L–T–P: 3–2–0**

Module No.	Contents	Teaching Hours
I	*The Upanishads* Valmiki: *The Ramayana* Vyasa: *The Mahabharata* Shudraka: *Mrichhakatikam*	20
II	Thiruvalluvar: Select portions of *Tirukkuṛaḷ* Kabir: Select Poems of Kabir Guru Nanak: *Japji – The Morning Prayer* Mirza Ghalib: Select Poems of Mirza Ghalib	16
III	Bankim Chandra Chatterjee: *Anandamath* Rabindranath Tagore: *Gitanjali* Munshi Premchand: *Kafan*	16

References:

Assaduddin, M, ed. *Penguin Book of Classic Urdu Stories*. New Delhi: Penguin/Viking, 2006. Print.

Chatterji, Bankimcandra. *Anandamath or The Sacred Brotherhood.* Trans and Intro. Julius. J. Lipner. New York: Oxford University Press, 2005. Print.

Ganguli, K.M., trans. *The Mahabharata*. 4 vols. New Delhi: Munshiram Manoharlal, 2008. Print.

Sen, Makhan Lal. *The Ramayana of Valmiki*. New Delhi: Munshiram Manoharlal, 2008. Print.

Shudraka. *The Clay Toy-Cart: Mrchchakatikam*. New Delhi: Penguin India, 2018. Print.

Singh, Karan, ed. *Treasury of Indian Wisdom*. New Delhi: Penguin India, 2010. Print.

Tagore, Rabindranath. *Gitanjali*. New Delhi: Rupa, 2002. Print.

Thiruvalluvar. *Tirukkuṛaḷ*. Web. Dec 15, 2017.
Source: https://thirukkural133.wordpress.com/contents/

Outcome:

- Students will be inspired by Indian thought, ethos, ethics, history and lives.
- Students will improve their communication skills.
- Students will become excellent public speaker.
- Student will master techniques for designing and delivering clear and compelling presentations.

Assessment

Scheme of examination & marks:

BELO 0006: Introduction to General Linguistics

Objective: Language being one of the essential, inherent requirements of human being, this course is specifically meant to develop the understanding and sense of the students on varied aspects of Language and Linguistics. The course intends to offer basic input of theoretical Linguistics, which should help the students to better appreciate the phenomenon of language and its paraphernalia.

Credits: 04 **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Language and Linguistics:** Introducing Linguistics Indian and Greco-Roman Philosophy of Language Design Features of Language The functions of Language Behaviorist and Cognitive approach to language Sassurian and Chomskian Linguistics **Morphology:** Types of morpheme: Morph, Morpheme and allomorph Derivational and Inflectional morphology Language Typology	**20**
II	**Semantics** What is semantics? Approaches to the study of meaning: Entitlement, Presupposition, Pragmatics, Synonmymy, Antonymy, Polysemy, Hyponymy and Homonymy **Phonetics and Phonology** The organs of speech, Active and passive articulators Articulation: Manner and Place IPA: with particular reference to Consonants, vowels, clusters, Diphthongs of English Syllable and word stress Phonetic and phonemic transcription	**20**
III	**Syntax** Grammar and syntax Phrase structure grammar to minimalism: overview Tree diagram of simple sentences **Sociolinguistics** Language and Gender Language and Social class Politics of Langauge **Language and Culture** Linguistic Relativity/ Sapir-whorf hypothesis Communicative competence **Pragmatics** Speech Acts Politeness	**20**

References: (1) _____; (2) _____; (3) _____

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

1. Develop their understanding on various branches of linguistics.
2. Understand and appropriately use the basic terms in linguistics.
3. Understand and explain the theoretical concepts of the different branches of study of language.
4. Appreciate the scope of different branches and domains of study of language.

BELO0011: REMEDIAL ENGLISH

Introduction: *The course will include intensive reading, writing, and some listening practices thereby helping the students in improving their English.*

Objective: *The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.*

Credits: 04 **Semester: II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	STRUCTURE A.1. **Tense and Voice:** Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change. A.2. Reading Comprehension i. **Analyzing a Text:** Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures & vocabulary; Analysis of the content of the text: interactive session. ii. **Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	15
II	B.1 **Parts of Speech:** Noun: countable and uncountable; Pronoun: Personal Pronoun; Adjective; Adverb; Preposition B.2. Reading Comprehension i. Analyzing a Text Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures & vocab; Analysis of the content of the text: interactive session. ii. Analyzing Unseen Passages (a) Reading a specimen text (b) Contextualising the text (c) Vocabulary and sentence structure	15
III	C.1. **Narration:** Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech. C.2. Reading Comprehension: i. **Reading an Essay:** Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers. ii. **Analyzing Unseen Passages:** Reading a specimen text; Contextualising the text; Vocabulary and sentence structure C. 3.THEME BASED WRITING Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings	15

	and Places, Car Parts , City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey), Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House, Restaurant, Tools, Transportation, Vegetables, Weather	

Text Books:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Robert J. Dixon. *Complete Course in English.* A new revised edition

References:

- Hornby, A.S., Advanced Learners' Dictionary of Current English, OUP
- Greenberg, Rondinone & Wiener. The Advancing Writer Book I, Harper Collins, College Publishers.
- Liz and Soars. Headway Pre-Intermediate. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup & Sons, Delhi

Course Outcomes: *After completion of the course, student will be able to:*

1. *Understanding about formation of sentence structure with the help of tenses.*
2. *Understanding the idea of expression with in the comprehensive.*
3. *Remembering new vocabulary in terms of contextual and situational conversation.*
4. *Understanding and enhancing listening skills, theme-based writing through the video of the text.*

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes(Cos) with Program Outcomes(Pos) and Program Specific Outcomes (PSOs)	
COs	Pos and PSOs
• CO1	PO5,PO6,PO7, PSO5,PSO6,PSO7
• CO2	PO1,PO2, PSO1, PSO2
• CO3	PO2,PO4, PSO2,PSO4,
• CO4	PO3, PSO3, PO4,PSO4,

BELO0011: REMEDIAL ENGLISH

Introduction: *The course will include intensive reading, writing, and some listening practices thereby helping the students in improving their English.*

Objective: *The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.*

Credits: 04 **Semester: III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**STRUCTURE** **A.1. Tense and Voice:** Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change. **A.2. Reading Comprehension** **i. Analyzing a Text:** Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures & vocabulary; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	**15**
II	**B.1 Parts of Speech:** Noun: countable and uncountable; Pronoun: Personal Pronoun; Adjective; Adverb; Preposition **B.2. Reading Comprehension** **i. Analyzing a Text** Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures & vocab; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages** (a) Reading a specimen text (b) Contextualising the text (c) Vocabulary and sentence structure	**15**
III	**C.1. Narration:** Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech. **C.2. Reading Comprehension:** **i. Reading an Essay:** Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualising the text; Vocabulary and sentence structure **C. 3.THEME BASED WRITING** Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings and Places, Car Parts , City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey), Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House,	**15**

	Restaurant, Tools, Transportation, Vegetables, Weather	

Text Books:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Robert J. Dixon. *Complete Course in English.* A new revised edition

References:

- Hornby, A.S., Advanced Learners' Dictionary of Current English, OUP
- Greenberg, Rondinone & Wiener. The Advancing Writer Book I, Harper Collins, College Publishers.
- Liz and Soars. Headway Pre-Intermediate. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup & Sons, Delhi

Course Outcomes: *After completion of the course, student will be able to:*

1. *Comprehend a text and answer the questions based on it clearly.*
2. *Express their ideas in writing according to time and tense.*
3. *Enrich their vocabulary in terms of contextual and situational conversation.*
4. *Enhance their listening skills through the video of the text*

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcome (PSOs)	
Cos	**Pos and PSOs**
CO1	PO1, PO2/ PSO2, PSO3
CO2	PO7, PO4/ PSO1, PSO4
CO3	PO3, PO5/ PSO5, PSO6
CO4	PO2,PO6/ PSO4, PSO7

BELO0011: REMEDIAL ENGLISH

Introduction: *The course will include intensive reading, writing, and some listening practices thereby helping the students in improving their English.*

Objective: *The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.*

Credits: 04 **Semester: III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**STRUCTURE** **A.1. Tense and Voice:** Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change. **A.2. Reading Comprehension** **i. Analyzing a Text:** Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures & vocabulary; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	**15**
II	**B.1 Parts of Speech:** Noun: countable and uncountable; Pronoun: Personal Pronoun; Adjective; Adverb; Preposition **B.2. Reading Comprehension** **i. Analyzing a Text** Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures & vocab; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages** (a) Reading a specimen text (b) Contextualising the text (c) Vocabulary and sentence structure	**15**
III	**C.1. Narration:** Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech. **C.2. Reading Comprehension:** **i. Reading an Essay:** Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualising the text; Vocabulary and sentence structure **C. 3.THEME BASED WRITING** Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings and Places, Car Parts , City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey), Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House,	**15**

	Restaurant, Tools, Transportation, Vegetables, Weather	

Text Books:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Robert J. Dixon. *Complete Course in English.* A new revised edition

References:

- Hornby, A.S., Advanced Learners' Dictionary of Current English, OUP
- Greenberg, Rondinone & Wiener. The Advancing Writer Book I, Harper Collins, College Publishers.
- Liz and Soars. Headway Pre-Intermediate. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup & Sons, Delhi

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

- Comprehend a text and answer the questions based on it clearly.
- Express their ideas in writing according to time and tense.
- Appreciate their vocabulary in terms of contextual and situational conversation.
- Augment their listening skills through the video of the text.

Focus: This course focuses on employability and skill development, aligned with all the COs.

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO3/PSO2, PSO3
CO3	PO4/PSO4
CO4	PO6, PO7/PSO6

BELO0011: REMEDIAL ENGLISH

Introduction: *The course will include intensive reading, writing, and some listening practices thereby helping the students in improving their English.*

Objective: *The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.*

Credits: 04 **Semester: III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**STRUCTURE** **A.1. Tense and Voice:** Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change. **A.2. Reading Comprehension** **i. Analyzing a Text:** Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures & vocabulary; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	**15**
II	**B.1 Parts of Speech:** Noun: countable and uncountable; Pronoun: Personal Pronoun; Adjective; Adverb; Preposition **B.2. Reading Comprehension** **i. Analyzing a Text** Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures & vocab; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages** (a) Reading a specimen text (b) Contextualising the text (c) Vocabulary and sentence structure	**15**
III	**C.1. Narration:** Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech. **C.2. Reading Comprehension:** **i. Reading an Essay:** Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualising the text; Vocabulary and sentence structure **C. 3.THEME BASED WRITING** Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings and Places, Car Parts , City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey), Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House,	**15**

	Restaurant, Tools, Transportation, Vegetables, Weather	

Text Books:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Robert J. Dixon. *Complete Course in English.* A new revised edition

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- Liz and Soars. Headway Pre-Intermediate. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup & Sons, Delhi

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

1. Comprehend a text and answer the questions based on it clearly.
2. Express their ideas in writing according to time and tense.
3. Appreciate their vocabulary in terms of contextual and situational conversation.
4. Augment their listening skills through the video of the text.

Focus: This course focuses on employability and skill development, aligned with all the COs.

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO3/PSO2, PSO3
CO3	PO4/PSO4
CO4	PO6, PO7/PSO6

BELO0011: REMEDIAL ENGLISH

Introduction: *The course will include intensive reading, writing, and some listening practices thereby helping the students in improving their English.*

Objective: *The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.*

Credits: 04 **Semester: II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**STRUCTURE** **A.1. Tense and Voice:** Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change. **A.2. Reading Comprehension** **i. Analyzing a Text:** Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures & vocabulary; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	**15**
II	**B.1 Parts of Speech:** Noun: countable and uncountable; Pronoun: Personal Pronoun; Adjective; Adverb; Preposition **B.2. Reading Comprehension** **i. Analyzing a Text** Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures & vocab; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages** (a) Reading a specimen text (b) Contextualising the text (c) Vocabulary and sentence structure	**15**
III	**C.1. Narration:** Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech. **C.2. Reading Comprehension:** **i. Reading an Essay:** Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualising the text; Vocabulary and sentence structure **C. 3.THEME BASED WRITING** Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings and Places, Car Parts , City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey),	**15**

	Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House, Restaurant, Tools, Transportation, Vegetables, Weather	

Text Books:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Robert J. Dixon. *Complete Course in English.* A new revised edition

References:

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- Greenberg, Rondinone & Wiener. The Advancing Writer Book I, Harper Collins, College Publishers.
- Liz and Soars. Headway Pre-Intermediate. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup & Sons, Delhi

Course Outcomes: *After completion of the course, student will be able to:*

1. Understand the sense of *text and answer the questions based on it clearly.*
2. *Express their ideas in writing according to time and tense.*
3. *Enrich their vocabulary in terms of contextual and situational conversation.*
4. *Enhance their listening skills through the video of the text*

Focus: This course focuses on employability and skill development, aligned with all the COs.

COs	POs / PSOs
CO1	PO1, PO4 / PSO1, PSO3
CO2	PO1 / PSO1, PSO2
CO3	PO1, PO6 / PSO2, PSO6
CO4	PO1, PO6 / PSO1, PSO2, PSO6

BELO0011: REMEDIAL ENGLISH

Introduction: *The course will include intensive reading, writing, and some listening practices thereby helping the students in improving their English.*

Objective: *The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.*

Credits: 04 **Semester: II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**STRUCTURE** **A.1. Tense and Voice:** Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change. **A.2. Reading Comprehension** **i. Analyzing a Text:** Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures & vocabulary; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages:**Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	**15**
II	**B.1 Parts of Speech:**Noun: countable and uncountable; Pronoun: Personal Pronoun; Adjective; Adverb; Preposition **B.2. Reading Comprehension** **i. Analyzing a Text** Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures & vocab; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages** (a) Reading a specimen text (b) Contextualising the text (c) Vocabulary and sentence structure	**15**
III	**C.1. Narration:**Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech. **C.2. Reading Comprehension:** **i. Reading an Essay:**Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers. **ii. Analyzing Unseen Passages:**Reading a specimen text; Contextualising the text; Vocabulary and sentence structure **C. 3.THEME BASED WRITING** Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings and Places, Car Parts , City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey), Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House,	**15**

	Restaurant, Tools, Transportation, Vegetables, Weather	

Text Books:

- Murphy, Raymond,*Intermediate English Grammar.* Cambridge University Press.
- Robert J. Dixon. *Complete Course in English.* A new revised edition

References:

- Hornby, A.S., Advanced Learners' Dictionary of Current English, OUP
- Greenberg, Rondinone& Wiener. The Advancing Writer Book I, Harper Collins, College Publishers.
- Liz and Soars. Headway Pre-Intermediate. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup& Sons, Delhi

Intended Outcomes:*After completion of the course, student will be able to:*

1. *Comprehend a text and answer the questions based on it clearly.*
2. *Understand the importance of the use of tenses in writing*
3. *Application of their vocabulary in terms of contextual and situational conversation.*
4. *Enhance their listening skills through the video of the text*

Focus: This course focuses on employability and skill development, aligned with all the COs.

COs	POs/ PSOs
CO1	PO1/PSO2
CO2	PO3/PO3
CO3	PSO3
CO4	PSO5

BP105T.COMMUNICATION SKILLS (Theory)

30 Hours

Scope: This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

Objectives:

Upon completion of the course the student shall be able to

1. Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
2. Communicate effectively (Verbal and Non Verbal)
3. Effectively manage the team as a team player
4. Develop interview skills
5. Develop Leadership qualities and essentials

Course content:

UNIT – I **07 Hours**

- **Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context

- **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers

- **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment

UNIT – II **07 Hours**

- **Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication

- **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style

UNIT – III **07 Hours**

- **Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations
- **Effective Written Communication:** Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication
- **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message

UNIT – IV **05 Hours**

- **Interview Skills:** Purpose of an interview, Do's and Dont's of an interview
- **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery

UNIT – V **04 Hours**

- **Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

BP111P.COMMUNICATION SKILLS (Practical)

2 Hours / week

Thefollowing learning modules are to be conducted using wordsworth® English language lab software

Basic communication covering the following topics

Meeting People

Asking Questions

Making Friends

What did you do?

Do's and Dont's

Pronunciations covering the following topics

Pronunciation (Consonant Sounds)

Pronunciation and Nouns

Pronunciation (Vowel Sounds)

Advanced Learning

Listening Comprehension / Direct and Indirect Speech

Figures of Speech

Effective Communication

Writing Skills

Effective Writing

Interview Handling Skills

E-Mail etiquette

Presentation Skills

Recommended Books: (Latest Edition)

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals – PHI, 2011
8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011
11. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

Business Communication-I

MELH0004

Credit: 04 **Semester: I** **L–T–P: 4-0-0**

Course Objectives

Course Objectives:

1. To develop awareness of the complexity of the communication process

2. To develop effective listening skills in students so as to enable them to comprehend instructions and become a critical listener

3. To develop effective oral skills so as to enable students to speak confidently interpersonally as well as in large groups

4. To develop effective writing skills so as enable students to write in a clear, concise, persuasive and audience centered manner

Oral Skills

Module No.	Contents	Teaching Hours
I	Profiling, Introduction to the syllabus Forms and Types of communication Levels and Flow of Communication Barriers to Communication Data description/speech/opinion on a given topic Basics in phonetics: English Sounds, Syllabus and Stress Reading the Dictionary Pronunciation Guidelines Drilling in Listening	15
II	Presentation Skills: Purpose, Organization, Preparation, Time and Audience Do's and Don'ts of PowerPoint Slides Do's and Don'ts of Delivery of Presentation Group PowerPoint Presentations by the Students Negotiation Skills Group Discussion	15

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:

1. *Business communication* – Meenakshi Raman, Prakash Singh, Oxford university press
2. *Foundations of Business communication*, India Edition – Dona. J. Young, Tata Mcgraw – Hill
3. *English for Engineers*. Dubey, Shyam Ji, Manish Kumar and Shreesh Chaudhary Vikas Publishing House

4.

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

1. Communicate effectively in a business environment
2. Listen, comprehend and respond to native speakers
3. deliver presentations in a better way
4. write in persuasive and polite style
5. prepare long and short reports

6. prepare official documents like memo, notice, circular etc.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Pos and PSOs
CO1	PO2,PO7, PO8, PO9
CO2	PO8, PO7, PO4
CO3	PO7, PO8
CO4	PO4, PO8
CO5	PO4, PO7, PO8, PO9
CO6	PO8, PO9, PO10

Business Communication-II

MELH0005

Credit: 04 **Semester: II** **L–T–P**

Course Objectives:

1. To develop awareness of the complexity of the communication process

2. To develop effective listening skills in students so as to enable them to comprehend instructions and become a critical listener

3. To develop effective oral skills so as to enable students to speak confidently interpersonally as well as in large groups

4. To develop effective writing skills so as enable students to write in a clear, concise, persuasive and audience centered manner

Oral Skills

Module No.	Contents	Teaching Hours
I	• Recapitulation of presentation skills • Individual presentation • Telephonic conversation • Using modern tools for communication • Marketing communication: Importance of feedback on services • Workplace humour • Reading skills and comprehension of technical materials	15
II	• Interview skills • Teleconferencing and videoconferencing • Negotiation • Perception and communication • Communication and personal identity • Communication at workplace	15

Writing Skills

Module No.	Contents	Teaching Hours
I	• Elements of effective writing • Corporate vocabulary • Object description • Process description • Note making and note taking • Summarizing and paraphrasing • Manual writing	15
II	• Project proposal writing • Precis writing • Paragraph writing • Writing quotations, orders and tenders • Writing sales and circular letters • Writing claim and adjustment letters • Writing credit and collection letters	15

Reference Books:

- *Business communication* – Meenakshi Raman, Prakash Singh, Oxford university press
- *Effective technical communication* – M. Ashraf Rizvi, McGraw Hill Education
- *Communication in our lives* – Julia T. Wood, Cengage Learning
- *Business Correspondence and Report Writing - A Practical Approach to Business and Technical Communication* – R C Sharma, Krishna Mohan, Virendra Singh Nirban, McGraw Hill Education
- *English for Engineers.* - Dubey, Shyam Ji, Manish Kumar and Shreesh Chaudhary, Vikas Publishing House

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

1. Communicate effectively in a business environment
2. Listen, comprehend and respond to native speakers
3. Deliver presentations in a better way
4. Write in persuasive and polite style
5. Prepare long and short reports
6. Prepare official documents like memo, notice, circular etc.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Pos and PSOs
CO1	PO2,PO7, PO8, PO9
CO2	PO8, PO7, PO4
CO3	PO7, PO8
CO4	PO4, PO8
CO5	PO4, PO7, PO8, PO9
CO6	PO8, PO9, PO10

MELH5001: TECHNICAL WRITING

Course Objectives: To make the students understand the concepts ofvarious modes of written communication used to disseminate information within and outside an organization.

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	Forms & features of communication factors facilitating communication-communication channels, Flow of communication, Language skills-LSRW, Barriers to communication, Words and Phrases, Sentences and Paragraphs, Art of condensation reading comprehension, Analyzing audience, Organizing contents, Preparing an outline, Visual aids paragraph writing characteristics and methods Technical reports, Importance, Preparatory steps and Structure letters, Memos and E-mails- structure, Principles, Types.	20
II	Technical proposals- Definition, Types, Structure and Style. Journal articles/ Research papers- Nature, Significance and essentials. Job Application- Resume, Curriculum Vitae and Cover letter. Interviews-Types, Preparation, Success and Failure Factors. Agenda and minutes of a meeting. Note making & summarizingDissertation and Thesis- Definition, Characteristics Style and Presentation. Preparing List of References and Bibliography: Referencing Conventions	20

Text Books:

- R. Meenakshi and S. Sharma, Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2015.

Reference Books:

- M. A.Rizvi, Effective Technical Communication, New Delhi, Tata McGraw Hill, 2017.
- R.C.Sharma and K. Mohan, Business Correspondence and Report Writing, Tata McGraw Hill, New Delhi, 2017.

Course Outcomes:

After studying these topics, the student will be able to

CO1: Understand communication features

CO2: Learn writing skills to write technical reports, formal messages and letters

CO3: Know the writing of technical proposals, research papers, dissertation reports etc.

CO4: Make curriculum vitae, resume and agenda and minutes of a meeting

Focus: This course focuses on Employability and Skill Development, aligned with all the Cos.

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

COs	POs
CO1	PO7, PO8, PO9, PO10/ PSO4
CO2	PO7, PO8, PO9, PO10/ PSO4
CO3	PO7, PO8, PO9, PO10/ PSO4
CO4	PO7, PO8, PO9, PO10

COURSES

(w.e.f. Session 2020-21)

PhD

(FULL TIME/PART TIME)

PELE 0001: ADVANCED TOPICS OF RESEARCH IN LITERARY STUDIES

Course Description: This course introduces the students to a variety of Indian and Western luminaries and thinkers of great minds who reach eternal thoughts.

Course Objectives:

- To liberate the minds of students by strengthening their critical powers to have independent inquiry.
- To draw out distinctions from the careful assessment of arguments with conceptual analysis as research study.
- To illuminate that thinkers everywhere reach eternal thought, in Eastern literature and philosophy , Western literature and philosophy and all literature and philosophy..
- To enable students to develop critical approach and to become practical and competent in their own work.

Credits: 04 **Semester: I** **L–T–P: 4–0-0**

Module No.	Contents	Teaching Hours
I	**Indian Literature:** • Thirukkural, A Great Masterpiece in World Literature Book 1: 1-10 Chapters • Dvait Literature-Madhvacharya • Advait Literature -Adi Shankarar • Vishistadvait Literature- Ramanujacharya • Nayanmar and Azhwar –Literature of Bhakti movement • Teachings and philosophy of Vivekananda • Guru Nanak's Call of the Soul: Japji Sahib • Saint Kabir's couplet-25	30
II	**Western Literature :** • Socrates as father of Western Philosophy • Immanuel Kant's Moral Theory • Benedict De Spinoza -His ethical vision unfolding out of a monistic metaphysics • RW Emerson and his interaction with Indian thoughts in Brahma • Henry David Thoreau, the American Yogi	30

Course Outcomes: On successful completion of the course, students should be able

1. to show the practical abilities by comparing the various philosophies and Literature for their research work.
2. to identify that thinkers everywhere reach eternal thought.
3. use and expand domain knowledge in English and Literary Studies to create a specific context for research.
4. problematize existing or potential themes, terms or tools of a select area of Literary Studies and choose an appropriate methodology
5. use corpus and tools devised for specifying the research universe

Focus: This course focuses on employability and skill development, aligned with all the COs.

Books Recommended:

1. Parimelalhagar (2009). [Tirukkural Original Text and Parimelalhagar Commentary]. Compiled by V. M. Gopalakrishnamachariyar. Chennai: Uma Padhippagam. 1456 pp.
2. Sharma, B. N. Krishnamurti (1962). Philosophy of Śrī Madhvācārya. Motilal Banarsidass (2014 Reprint). ISBN 978-8120800687.

3. Shivnarayan Joshi Shivji (1 January 1992). A Critique of Indian Dualism. Scientific Publishers. ISBN 9788172330224
4. Arvind Sharma (1993). The Experiential Dimension of Advaita Vedanta. Motilal Banarsidass. p. 27, 72–83. ISBN 978-81-208-1058-7.
5. Singh, Sahib. Guru Nanak Dev and His Teachings.
6. Sarwal, Anil (1996). "Guru Nanak and Miracles". Miracles in Religion: A Study of the miraculous in religion in context of the Bahá'í Faith. Lucknow: Royale Publishers.
7. Kalidasa. AbhijnanaShakuntalam. Tr. Chandra Rajan, in Kalidasa: The Loom of Time. New Delhi: Penguin, 1989.
8. Nayanmars: The Shaivite saints Kindle Edition by Venkataraman M.
9. Alwars: The Vaishnavite Saints by Venkataraman M.Paperback-– Import, 8 November 2015.
10. Guthrie W.K.C. 1962. A history of Greek philosophy. Cambridge University Press, London. Volume 1 The earlier presocratics and the pythagoreans. Volume 2 The presocratic tradition from Parmenides to Democritus.
11. Lectures on Ethics, translated by Peter Heath and J.B. Schneewind, 2001
12. A Spinoza Reader: The Ethics and Other Works **Spinoza, Benedictus de** Published by Princeton University Press (1994)
13. Allen, Gay Wilson (1981). Waldo Emerson. New York: Viking Press. ISBN 0-670-74866-8.
14. Henry David Thoreau, Yogi' published in Xenophilia: A Symposium on Xenophobia's Contrary, Part 3 of the journal Common Knowledge (Vol 24, Issue 1, Duke University Press, 2018).

PELE 0002: ADVANCED TOPICS OF RESEARCH IN LANGUAGE STUDIES

Course Description: This course introduces the students to major trends- approaches, methods and techniques - in English language teaching; ELT in India; Testing & Evaluation; and the Structure of English. The course encourages close reading, honest response and clear expression as the key principles.

Course Objective: To acquaint scholars with the emerging trends in English Language Teaching and enable them to explore new research of areas in language teaching.

Credits: 04 **Semester: I** **L–T–P: 4–0-0**

Module No.	Contents	Teaching Hours
I	**Major Trends in English Language Teaching** • Approaches in English Language Teaching • Methods of Teaching English • Techniques of Teaching English **English Language Teaching in India** • History of English Language Teaching • English as Second Language (ESL) • English for Specific Purpose • The Problems of Teaching English	30
II	**Testing & Evaluation** • Types of Tests • Tools of Evaluation • Remedial Teaching **Structure of English** • English Phonetics & Phonology • English Syntax • English Lexicon	30

Course Outcome:

1. Upon the completion of the course scholars are expected to develop acumen for the issues in English language teaching research.
2. Learners are expected to learn about the different theories that have made their impact on literature.
3. They are able to make use of such theories and refer to literary review in their research papers
4. Learners are able to problematize potential themes in theory for practical use
5. Learners are able to use domain knowledge and tools responsibly in the professional field.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Books Recommended:

1. Abbott, G. & Wingard, P. (eds.) (1992) Teaching of English as an International Language. A Practical Guide. Surrey: Nelson.
2. Balasubramanian, T. (1981).A Textbook of English Phonetics for Indian Students. New Delhi: Macmillan.
3. Celce-Murcia, M. M. (ed.) (1991) Teaching English as a Second or Foreign Language. Rowley, MA: Newbury House.
4. Crystal D. (1991).A Dictionary of Linguistics and Phonetics, Blackwell Publishers.
5. Crystal, D. (1987).The Cambridge Encyclopedia of Language. Cambridge: CUP.

6. Crystal, David. (1987) The Cambridge Encyclopedia of Language. Cambridge, England: Cambridge University Press
7. David Nunan. (1998) Language Teaching Methodology. NJ: Prentice Hall
8. Desmond M. Allison. (1999) Language Testing and Evaluation: An Introductory Course. Singapore: World Scientific Publishing Company
9. Diane Larsen-Freeman (2000). Techniques and Principles in Language Teaching, OUP.
10. Doff, Adrian. (1988) Teach English – A Training Course for Teachers. Cambridge, England: Cambridge University Press
11. Harmer, J. (2007).The Practice of Teaching English, 4th edition. Pearson Longman.
12. Laurel J. Brinton. (2000) The Structure of Modern English: A Linguistic Introduction. Amesterdam: John Benjamins Publishing Company
13. Raghubir Sahai Gupta, Kapil Kapoor. (1991) English in India, Issues and Problems. New Delhi: Academic Foundation
14. Richards J. and Rodgers T. (2002) Approaches and Methods in Language Teaching. Cambridge: CUP
15. Scrivener, J. (1994). Learning Teaching: A Guidebook for English Language Teachers. Oxford: Heinemann.
16. Thirumala, M.S. (2002) An Introduction to TESOL, Mysore: Central Institute of Indian Language.
17. Ur, Penn. (1996).A Course in Language Teaching: Practice and Theory. Cambridge: CUP
18. Yule, G. (2010) The Study of Language, 4th edition. CUP.

PELE 0003: ADVANCED TOPICS OF RESEARCH IN TRANSLATION STUDIES

Course Description: This course deals with the art of translation with its focus on both theory and practice. In this course, selected topics will be discussed in order to train students for of problem–solving and improve their critical thinking with reference to translation as a process and as a product.

Course Objectives: The primary objective is to enable students to

- acquire the body of theoretical literature on translation,
- gain the basic knowledge of the field of translation studies, and
- apply the acquired knowledge in translational act.

Credits: 04 **Semester: I** **L–T–P: 4–0-0**

Module No.	Contents	Teaching Hours
I	**A brief History of Translation studies** • Translation Studies and Types of Translation • Scope of Translation Theory **Translation theory before 20th century** • 'Word for Word' or 'Sense for Sense' Translation • Early attempts at Systematic Theories - Dryden , Dolet, Tytler • Schleiermacher and Valorization of the Foreign	30
II	**Theories of Translation** • The Polysystem theory • Descriptive translation studies • Translation norms. **Equivalence and Equivalent Effect** • Roman Jakobson : Three Types of Translation • Nida : Formal and Dynamic Equivalence • Newmark : Semantic and Communicative Translation	30

Course Outcomes: On successful completion of the course, students should be able

1. use advanced, field-specific conceptual, theoretical, and practical knowledge acquired,
2. analyze and research field-specific concepts and ideas and to interpret data individually or as a team using scientific methods,
3. understand and use grammatical and semantic structures of the source and target languages,
4. obtain information about social, cultural, and historical approaches within the source and target languages and to use this information for textual analysis and production,
5. understand and interpret written and oral texts in the source language and to transfer these texts into the target language using a semantically and functionally appropriate language,
6. produce creative translations and assess the translation products critically by defining the steps, strategies and problems in the translation process in the light of field-specific theoretical knowledge and skills acquired,
7. transfer the theoretical knowledge and research skills within different areas of expertise to translational act.

8. access necessary sources to improve quality at each step of the translation process and to assess the target text in accordance with the quality objectives by using these sources.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Books Recommended:

1. *Introducing Translation Studies* by Jeremy Munday. London: Routledge.
2. *Translation Studies* by Susan Bassnett. London: Routledge.
3. *Routledge Encyclopaedia of Translation Studies* by Mona Baker and Gabriela Saldanha, London: Routledge.
4. *The Translation Studies Reader* by Lawrence Venuti, London: Routledge.

PELH 0001: APPROACHES TO LITERARY/NON-LITERARY TEXTS

Course Description: This course introduces the students to a variety of productive approaches to literary and linguistic criticism. The course encourages close reading, honest response and clear expression as key principles.

Course Objectives:

- To introduce students to various approaches to literary and non-literary texts
- To enable students develop practical critical abilities
- To apply the approaches to selected texts

Credits: 04 **Semester: I** **L–T–P: 4–0-0**

Module No.	Contents	Teaching Hours
I	**Approaches (I)** **Modernism:** Terry Eagleton. "Capitalism, Modernism and Postmodernism." **Structuralism:** Claude Levi Strauss. "Incest and Myth." **Post-structuralism:** Jacques Derrida. "Structure, Sign and Play in the Discourse of the Human Sciences." **Post-modernism:** Frederic Jameson. "The Cultural Logic of Late Capitalism."	**20**
II	**Approaches (II)** **Discourse Analysis and Stylistics** • Pragmatics and Interpretation of Conversation; Speech Acts; Conversational Implicature; Politeness Strategies; Sample Analysis **Discourse Structure and Point of View** • **Levels of Style** Semantic: Syntactic Graphological Phonological • **Stylistic Variations** Idiolects Registers Dialects 'Indian English' as a Variety of English Sample Analysis	**20**

III	**Approaches (III) Literature** **Marxist Studies:** Walter Benjamin, "The Work of Art in the Age of Mechanical Reproduction" **Literature and Psychology:** Hertz, Neil: "Dora's Secrets, Freud's Techniques." **Gender and Queer Discourse:** Judith Butler. "Bodily Inscriptions, Performative Subversions" **Postcolonial Studies:** Frantz Fanon. "On National Culture." **Cultural Studies**		**Approaches (III) Text Linguistics and Stylistics** Structure of English language	**20**

Course Outcomes: On successful completion of the course, students should be able

1. To show the practical abilities by applying these approaches to different types of texts
2. To deconstruct literary and non-literary texts
3. Use and expand domain knowledge in English and Literary Studies to create a specific context for research.
4. Problematize existing or potential themes, terms or tools of a select area of Literary Studies and choose an appropriate methodology
5. Use corpus and tools devised for specifying the research universe

Focus: This course focuses on employability and skill development, aligned with all the COs.

Books Recommended:

1. Allan, Margaret. *Teaching English with Video*. Longman, 1989.
2. Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural. Theory, Viva Books,2010.
3. Brinton, Laurel J. *The Structure of Modern English: A Linguistic Introduction*. OUP, 2010.
4. Frantz Fanon. "On National Culture." The Wretched of the Earth. Penguin Books,
5. Frederic Jameson. "The Cultural Logic of Late Capitalism." Postmodernism and
6. Hertz, Neil: "Dora's Secrets, Freud's Techniques." *Diacritics*, Spring, (1983), pp. 83-86
7. Khan, Arif Ali., and Anil Saxena. *English Language Teaching*. Shree Publishers & Distributors, 2012.
8. Leech, Geoffrey N., and Mick Short. *Style in Fiction: A Linguistic Introduction to English Fictional Prose*. London: Longman.
9. Lodge, David. Ed. Twentieth Century Literary Criticism. London: Longman, 1972 pp. 166-99.
   Reader. Ed. Simon During. Routledge. pp. 97-112.
10. Salkie, Raphael. *Text and Discourse Analysis*. London: Routledge, 1995.
11. Stuart Hall. "Cultural Studies and Its Theoretical Legacies." Cultural Studies:

12. Terry Eagleton. "Ideology and its Vicissitudes in Western Marxism from Lukacs to Gramsci." Mapping Ideology. ed. Slavoj Zizek. London: Verso. pp. 179-226.
13. Terry, Eagleton. *Literary theory: An Introduction*, University of Minnesota Press. the Contemporary Novel: A Reader. Ed. Bran Nicol, pp. 20-39.
14. Vincent, B.ed. *Norton Anthology of Theory & Criticism,* WW Norton & Co.
15. Walter Benjamin (1968). Hannah Arendt, ed. "The Work of Art in the Age of Mechanical Reproduction", Illuminations. London: Fontana. pp. 214–18

PELH 0002: INTERPRETATION OF LITERARY/NON-LITERARY TEXTS

Course Description: This course is an introduction to the critical analysis of literary and non-literary texts. It will seek to deepen the student's understanding and appreciation of a variety of texts.

Course Objective:

- To help students develop their ability to make critical judgments and express them effectively
- To help students learn to interpret and draw conclusions
- To teach students how to publish articles

Credits: 04 **Semester: I** **L–T–P: 4–0-0**

Module No.	Contents	Teaching Hours
I	**Analyzing Fiction / Non-Literary Text(s)*** Toni Morrison – *Beloved* (1987) **OR** Michael Ondaatje – *The English Patient* (1992) **OR** Amitav Ghosh – *The Glass Palace* (2000) **OR**	**20**
II	**Analysing Drama/ Non-Literary Text(s)*** Tom Stoppard – *Rosencrantz and Guildenstern Are Dead* (1966) **OR** Wole Soyinka – *Death and the King's Horseman* (1975) **OR** Girish Karnad – *Wedding Album* (2009) **OR**	**20**
III	**Analysing Poetry and Prose/ Non-Literary Text(s)*** i. Arun Kolatkar – *Jejuri* (1976) ii. Arundhati Roy : The Greater Common Good (1999) **OR** i. Allen Ginsberg – Howl (1956) ii. Bertrand Russell – Nobel Prize Acceptance Speech "What Desires Are Politically Important?" (1950) **OR** i. Derek Walcott – *12* from *The Prodigal* (2004) ii. Steve Jobs – 2005 Stanford Commencement address	**20**

Note: To be decided by the course instructor after a discussion with the students.

Course Outcome: On successful completion of the course, students should be able

- to write research papers in the areas of literature, text linguistics or ELT
- to work on thesis independently

Books Recommended:

1. Frenz, Horst, ed. *Nobel Lectures, Literature 1901-1967. Amsterdam:* Elsevier Publishing Company, 1969. Print.
2. Ghosh, Amitav. *The Glass Palace*. New Delhi: HarperCollins Publisher. 2011. Print.
3. Ginsberg, Allen. *Howl, Kaddish and Other Poems.* USA: Penguin Classics. 2009. Print.
4. Jobs, Steve. "2005 Stanford Commencement Address." Stanford News, 14th June, 2005.Web.
5. Karnad, Girish. *Wedding Album*. New Delhi: OUP. 2009. Print.
6. Kolatkar, Arun, *Jejuri*. New York: New York Review Books, 2005. Print.
7. Morrison, Toni. Beloved. New York: Random House. 2010. Print.
8. Ondaatje, Michael. *The English Patient*. London: Bloomsbury Publishing. 2004. Print.
9. Roy, Arundhati. "The Greater Common Good." Outlook, 24th May 1999. Web.
10. Soyinka, Wole. *Death and the King's Horseman*. New York: W W Norton & Co Inc. 2002. Print.
11. Stoppard, Tom. *Rosencrantz and Guildenstern Are Dead*. UK: Faber and Faber. 1971. Print.
12. Walcott. Derek. *The Prodigal*. UK: Faber and Faber. 2006. Print.

PELH 0002: INTERPRETATION OF LITERARY/NON-LITERARY TEXTS

Course Description: This course is an introduction to the critical analysis of literary and non-literary texts. It will seek to deepen the student's understanding and appreciation of a variety of texts.

Course Objective:

- To help students develop their ability to make critical judgments and express them effectively
- To help students learn to interpret and draw conclusions
- To teach students how to publish articles

Credits: 04 **Semester: I** **L–T–P: 4–0-0**

Module No.	Contents	Teaching Hours
I	**Analyzing Fiction / Non-Literary Text(s)*** Toni Morrison – *Beloved* (1987) **OR** Michael Ondaatje – *The English Patient* (1992) **OR** Amitav Ghosh – *The Glass Palace* (2000) **OR**	**20**
II	**Analysing Drama/ Non-Literary Text(s)*** Tom Stoppard – *Rosencrantz and Guildenstern Are Dead* (1966) **OR** Wole Soyinka – *Death and the King's Horseman* (1975) **OR** Girish Karnad – *Wedding Album* (2009) **OR**	**20**
III	**Analysing Poetry and Prose/ Non-Literary Text(s)*** i. Arun Kolatkar – *Jejuri* (1976) ii. Arundhati Roy : The Greater Common Good (1999) **OR** i. Allen Ginsberg – Howl (1956) ii. Bertrand Russell – Nobel Prize Acceptance Speech "What Desires Are Politically Important?" (1950) **OR** i. Derek Walcott – *12* from *The Prodigal* (2004) ii. Steve Jobs – 2005 Stanford Commencement address	**20**

Note: To be decided by the course instructor after a discussion with the students.

Course Outcome: On successful completion of the course, students should be able

1. to write research papers in the areas of literature, text linguistics or ELT
2. to work on thesis independently

3. critically interact with works conscious of their own socio-historic specificity and thus their level of critical thinking is enhanced.
4. become thorough with reading works with theoretical basis
5. Students become capable of interpreting and exploring relationships from the points of view of different people.

Books Recommended:

1. Frenz, Horst, ed. *Nobel Lectures, Literature 1901-1967. Amsterdam:* Elsevier Publishing Company, 1969. Print.
2. Ghosh, Amitav. *The Glass Palace*. New Delhi: HarperCollins Publisher. 2011. Print.
3. Ginsberg, Allen. *Howl, Kaddish and Other Poems.* USA: Penguin Classics. 2009. Print.
4. Jobs, Steve. "2005 Stanford Commencement Address." Stanford News, 14th June, 2005.Web.
5. Karnad, Girish. *Wedding Album*. New Delhi: OUP. 2009. Print.
6. Kolatkar, Arun, *Jejuri*. New York: New York Review Books, 2005. Print.
7. Morrison, Toni. Beloved. New York: Random House. 2010. Print.
8. Ondaatje, Michael. *The English Patient*. London: Bloomsbury Publishing. 2004. Print.
9. Roy, Arundhati. "The Greater Common Good." Outlook, 24th May 1999. Web.
10. Soyinka, Wole. *Death and the King's Horseman*. New York: W W Norton & Co Inc. 2002. Print.
11. Stoppard, Tom. *Rosencrantz and Guildenstern Are Dead*. UK: Faber and Faber. 1971. Print.
12. Walcott. Derek. *The Prodigal*. UK: Faber and Faber. 2006. Print.

PELH 0003: Research Methodology for English Studies

Course Objectives: This course aims to

- Introduce scholars to the philosophy and mechanics of research.
- Train scholars in the use of language, style and discourses suitable for thesis-writing.
- Help them acquire both a theoretical thrust and hands-on experience in writing research proposals and papers before they embark on the execution of their thesis.

Credits: 04 **Semester: I** **L–T–P: 4–0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Research** • What is research? • Objectives of Research • Research in Language and Literature • Qualitative and Quantitative Research; primary and secondary research • Identifying a research problem • Material & Tools of Research: Books, Journals, anthologies, articles, Conference Proceedings, Audio-visual resources, interviews, Field Studies, Web Resources	**20**
II	**Research Process** • Review of literature • Identifying and Defining Research problems • Formulation of hypothesis • Selection of topic: Study of Literatures, Framing of Topic statement • Writing a synopsis • Primary and secondary research sources • Bibliography: Compiling a working bibliography • Sampling: Need of sampling; Requisites of a good sample, Probability & Non-Probability Sampling Methods; Random Sampling • Surveys and Interviews	**20**
III	**Documentation Style & The Mechanics of Writing (MLA, APA)** • Plagiarism: definition, forms, consequences, plagiarism check. • Note Taking: Methods • The use of Quotations, In-text citations • Citation of sources: Formulation of list of Works Cited (References): Electronics Sources • The Format of a Thesis: Planning, Drafting, Revising and Editing • Language and Style: Objectivity, clarity, coherence, Explanation-Argumentation-Exposition Use of correct Syntax	**20**

Course Outcomes: On successful completion of the course, students will be able to:

1. demonstrate knowledge of research processes
2. perform literature reviews using print and online databases
3. employ various formats for citations of print and electronic material
4. identify and prepare the key elements of a synopsis/research proposal
5. compare and contrast types of research paradigms
6. describe sampling methods and appropriate uses of each
7. display rationale and knowledge of research ethics
8. utilize the acquired research aptitude in writing papers and develop thesis in the research area.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Suggested Reading:

- Allison, B. *The Students' Guide to Preparing Dissertations and Theses*. London: Kogan Page
- Altick, Richard D. and John J. Fenstermaker. *The Art of Literary Research.* 4th ed. New York: Norton,
- Bryman, Alan. Social Research Methods. New York: Oxford University Press.
- Bachman, L.F. *Statistical Analysis for Language Assessment.* CUP.
- Davis, Gordon, B.; Clyde Parker *Writing the Doctoral Dissertation: A Systematic Approach.* Barrons Educational Series.
- Gibaldi, Joseph. *MLA Handbook for Writers of Research Papers.* Modern Language Association of America; 8th edition.
- Griffin, Gabriele. *Research Methods for English Studies*. New Delhi: Rawat Publications.
- Kothari, C.R. *Research Methodology: Methods and Techniques.* New Delhi: New Age International Ltd.
- Majumdar, P.K. *Research Methods in Social Science.* New Delhi. Viva Books Pvt. Ltd.
- Napier, Jemina. *Research Methods in Interpreting: A Practical Resource in Research Methods in Linguistics.* Bloomsbury.
- Nunan, D. *Research Methods in Language Learning*. CUP.
- Rahim, F. Abdul. *Thesis Writing: A Manual for Researchers*. New Delhi: New Age International P. ltd
- Brooks and Warren. *Modem Rhetoric* Harcourt Brace Jovanovich.
- Sinha, M.P. *Research Methods in English*. New Delhi: Atlantic Publishers.

PELH 0004: CURRENT APPROACHES TO ENGLISH STUDIES

(I) LITERARY STUDIES (II) LANGUAGE STUDIES (III) TRANSLATION STUDIES

Course Description: This course introduces the students to a variety of productive approaches to literary and linguistic criticism. The course encourages close reading, honest response and clear expression as the key principles.

Course Objectives:

- To introduce students to various approaches to literary and non-literary texts
- To enable students develop practical critical abilities
- To apply the approaches to the selected texts

Credits: 04 **Semester: I** **L–T–P: 4–0-0**

Module No.	Contents	Teaching Hours
I	**Modernism / Post Modernism** • Modernism and Literary History • Transition to post-modernism and its Impact on Literature **Structuralism / Post-Structuralism** • Structuralism- theory and its scope, • Structuralism in literary analysis • Post-structuralism as a reaction to structuralism and its tenets. **Current Trends in Literary Studies** • A brief history of colonization • Introduction to post-colonial theory **Gender and Queer Discourse** • Introduction to Gender Studies • Gender and Literature • Introduction to Cultural Studies • Current Trends in Cultural Studies **Comparative Literature** • Theoretical concepts, Scope and Relevance • Different Schools of Thought and Comparative Indian Literature	30
II	**Discourse Analysis and Stylistics** • Pragmatics and Interpretation of Conversation • Speech Acts • Conversational Implicature • Politeness Strategies • Sample Analysis **Levels of Style** • Semantic • Syntactic • Graphological • Phonological **Stylistic Variations** • Idiolects	30

	• Registers • Dialects • Indian English as a Variety of English • Sample Analysis **Structure of Indian English** • Standard English, World English, Indian English • Indian English Phonological Structure • Indian English Morphological Structure • Indian English Syntactical Structure • Indian English Lexicon	

Course Outcomes: On successful completion of the course, students should be able

1. To show the practical abilities by applying these approaches to different types of texts
2. To deconstruct literary and non-literary texts
3. Use and expand domain knowledge in critical theory to create new contexts for developing a research perspective.
4. Develop skill and vision in critical practice and choose a right methodology or modify existing methodologies for one's own use.
5. Pursue research in English studies with the awareness of the ethics of research.

Focus: This course focuses on employability and skill development, aligned with all the COs.

Books Recommended:

1. Allan, Margaret. *Teaching tfnglish with Video*. Longman, 1989.
2. Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural. Theory, Viva Books,2010.
3. Brinton, Laurel J. *The Structure of Modern tfnglish: A Linguistic Introduction*. OUP, 2010.
4. Frantz Fanon. "On National Culture." The Wretched of the Earth. Penguin Books,
5. Frederic Jameson. "The Cultural Logic of Late Capitalism." Postmodernism and
6. Hertz, Neil: "Dora's Secrets, Freud's Techniques." *Diacritics*, Spring, (1983), pp. 83-86
7. Khan, Arif Ali., and Anil Saxena. *tfnglish Language Teaching*. Shree Publishers & Distributors, 2012.
8. Leech, Geoffrey N., and Mick Short. *Style in Fiction: A Linguistic Introduction to tfnglish Fictional Prose*. London: Longman.
9. Lodge, David. Ed. Twentieth Century Literary Criticism. London: Longman, 1972 pp. 166-99. Reader. Ed. Simon During. Routledge. pp. 97-112.
10. Salkie, Raphael. *Text and Discourse Analysis*. London: Routledge, 1995.
11. Stuart Hall. "Cultural Studies and Its Theoretical Legacies." Cultural Studies:
12. Terry Eagleton. "Ideology and its Vicissitudes in Western Marxism from Lukacs to Gramsci." Mapping Ideology. ed. Slavoj Zizek. London: Verso. pp. 179-226.
13. Terry, Eagleton. *Literary theory: An Introduction*, University of Minnesota Press. the Contemporary Novel: A Reader. Ed. Bran Nicol, pp. 20-39.
14. Vincent, B.ed. *Norton Anthology of Theory & Criticism,* WW Norton & Co.
15. Walter Benjamin (1968). Hannah Arendt, ed. "The Work of Art in the Age of Mechanical Reproduction", Illuminations. London: Fontana. pp. 214–18
16. Bassnett, Susan. *Comparative Literature: An Introduction*. Blackwell, 1993.
17. *Translation studies: An introduction*, Routledge, 2002.
18. Dev, Amiya. *The Idea of Comparative Literature in India*. Calcutta. Papyrus, 1984.

19. Munday, Jeremy. *Introducing Translation Studies: Theories and applications*. Routledge, 2008.

SYLLABUS

B.SC. (HONS.) PHYSICS

BPHS0011: MECHANICS AND RELATIVITY

OBJECTIVES: Impart knowledge of fundamental laws of mechanics and relativity and make students to apply them for various domain relating to classical and relativistic mechanics.

Credits: 04 **Semester I** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Mechanics:** Conservation of momentum and Energy. Moment of inertia of rigid-bodies: solid sphere, solid cylinder, solid rod, hollow cylinder, parallel axis theorem and perpendicular axis theorem, radius of gyration, Center of mass (C.M), Lab and C.M frame of reference, motion of CM of system of particles subject to external forces, elastic, and inelastic collisions in one and two dimensions, Scattering angle in the laboratory frame of reference. **Mechanical Properties of Matter - I:** Modulus of rigidity, Poisson's ratio, relation connecting different elastic- constants, elastic behavior of solids, different types of elasticity, twisting couple of a cylinder (solid and hallow),	24
II	**Mechanical Properties of Matter – II:** Statistical method (Barton's method), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever (neglecting mass), Young modulus by bending of beam, Viscosity, Poiseulle's equation of liquid flow through a narrow tube. **Relativistic Mechanics:** Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation, mass- energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum, massless particles, relativistic momentum and force.	24

Reference Books/ Text Books :

* Physics Part –1: Resanick and Halliday.
* Mechanics : D.S.Mathur.
* Concept in Physics Vol. I : H.C.Verma.
* Mechanics : R.K.Shukla and Anchal Srivastava

*Classical Mechanics: J.C.Upadhyay

Focus: This course focuses on Employability aligned with CO1,CO6 and CO7.

Course Outcomes

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

CO1	Discuss conservation of momentum and energy.
CO2	Calculate moment of inertia of rigid-bodies like solid sphere, solid cylinder, solid rod and hollow cylinder.
CO3	Learn theorem of parallel/perpendicular axis, Center of mass (C.M), frame of reference, motion of CM of system of particles subject to external forces.
CO4	Explain elastic and inelastic collisions in one and two dimensions, Scattering angle in the laboratory frame of reference.
CO5	Understand mechanical properties of matter like rigidity, elasticity, viscosity and bending
CO6	Familiar with concepts of relativistic mechanics to obtain equations of Lorentz transformation, length contraction, time dilation, Relativistic velocity transformation and mass- energy relation.
CO7	Learn concept of zero rest mass of photon, relativistic relation between energy and momentum, massless particles, relativistic momentum and force.

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

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

BPHS1005: ANCILLARY PHYSICS COURSE – I (WAVES AND OSCILLATIONS)

OBJECTIVES: Provide knowledge of fundamental laws governing to motion of all types of waves specially SHM, Damped SHM and forced SHM and obtain working knowledge of various systems.

Credits: 04 **Semester I** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Wave motion:** Type of mechanical wave, wave length, frequency and wave number, progressive harmonic wave, differential equation of wave motion, energy density of plane progressive wave, superposition of wave, beats, propagation of longitudinal and transverse vibration along string, modes of vibration, Fourier's theorem, La'place correction of Newton's formula, group velocity and phase velocity **Simple Harmonic Motion - I:** Periodic and harmonic motion, simple harmonic motion, energy of harmonic oscillator, average value of kinetic and potential energy of H.O. mass spring system.	24
II	**Simple Harmonic Motion - II:** Two body harmonic oscillator, oscillation of diatomic molecule, time period of pendulum of large amplitude. Kapler's laws and its applications, equation of orbit, anharmonic motion. **Damped and forced Harmonic Motion:** Frictional effects-(damping), damped harmonic oscillator, power dissipation, quality factor (Q), example of damped H.O, driving (forced) harmonic oscillator, sharpness of resonance, phase of driving Oscillator, Velocity resonance, half width of resonance curve, power absorption. **S**uperposition principle driving L-C-R circuit, parallel resonance circuit, example and application.	24

Reference Books/ Text Books

* Physics Part –1: Resanick and Halliday.
* Mechanics : D.S.Mathur.

* Concept in Physics Vol. I : H.C.Verma.
* Mechanics : R.K.Shukla and Anchal Srivastava
*Classical Mechanics: J.C Upadhyay

Focus: This course focuses on Employability aligned with CO3 and CO6.

Course Outcomes

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

CO1	Discuss different type of waves and their properties and obtain differential equation of wave motion.
CO2	Discuss superposition of wave, beats and propagation of longitudinal and transverse vibration along string, modes of vibration, La'place correction of Newton's formula
CO3	Explain Periodic, harmonic motion, simple harmonic motion and calculate energy of harmonic oscillator like mass spring system.
CO4	Learn about two body harmonic oscillator, oscillation of diatomic molecule and calculation of time period of pendulum of large amplitude.
CO5	Understand Kapler's laws and its applications, equation of orbit, anharmonic motion.
CO6	Discuss Damped and forced Harmonic Motion of different physical systems.

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

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

BPHS1805 : PHYSICS LAB – I

OBJECTIVES: Experiments are designed based on the theoretical concepts and principles of the subjects which are taught to them.

Credits: 02 **Semester I** **L–T–P : 0–0–4**

1. Determination of modulus of rigidity and Poisson's ratio of material of a wire using Searle's method.
2. Determination of Young's modulus of material of a metallic bar by bending of beam method.
3. Determination of modulus of rigidity using Borton's apparatus.
4. Determination of viscosity of liquid using Poiseuille's method.
5. Determination of acceleration due to gravity using compound pendulum.
6. Determination of internal resistance of micro ammeter and conversion of micro ammeter into voltmeter, milliammeter and ohmmeter.
7. Determination of resistance per unit length and an unknown resistance using C.F.Bridge.
8. To determine specific resistance of wire by Carey Foster bridge.
9. Determination of absolute capacity of a condenser.
10. To study variation of magnetic field along the axis of Helmholtz Galvanometer and to determine reduction factor.
11. Determination of Energy band gap in a semiconductor diode.
12. To study series and parallel resonant L.C.R circuit.
13. Calibrations of Ammeter by using potentiometer.
14. Calibrations of Voltmeter by using potentiometer.

Focus: This course focuses on Employability and Skill development aligned with all CO's

Course Outcomes

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

CO1	Apply the various procedures and techniques for the experiments
CO2	Use the different measuring devices and meters to record the data with precision
CO3	Apply the mathematical concepts/equations to obtain quantitative results
CO4	Develop basic communication skills through working in groups in performing the laboratory experiments by interpreting the results

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

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

BPHS0012: Heat and Thermodynamics

OBJECTIVES: Gain the basic knowledge and principles of heat and thermodynamics and analyze different thermodynamical systems based on these principles.

Credits: 4 **Semester II** **L-T-P: 3-2-0**

Module No.	Content	Teaching Hours (Approx.)
I	**(Thermal radiation) :** Maxwell's speed distribution, Mean free path, Elementary treatment of transport phenomena, Viscous flow and Thermal conduction in gases. Real gases, Andrew's curves, Equation of state, Virial coefficients, Van der Waals equation, Critical constants, The blackbody spectrum, Wien's displacement law, Rayleigh-Jean's law, Planck's quantum theory of radiation. **(Thermodynamics-I) :** Zeroth and First law of thermodynamics, Carnot's cycle and Carnot's theorem. Second law of thermodynamics. Concept of entropy, Entropy change in reversible and irreversible processes. Entropy and disorder.	24
II	**(Thermodynamics-II) :** Principle of increase of entropy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram. Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations Clapeyron equations. Third law of thermodynamics, Nernst heat theorem. Criterion of equilibrium of a system, Isolated system, System in contact with constant temperature reservoir. System in contact with constant temperature and pressure reservoir, Phase transition, Coexistence of phases, Triple point. Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Van der Waals gas. Liquification of gases, Properties of liquid helium, Introduction to super-fluidity and superconductivity.	24

Reference Books/ Text Books

*Heat and Thermodynamics: K.W. Zeemansky.
*Thermal Physics: B.K. Agarwal.
*Heat and Thermodynamics: Brij Lal and N. Subramanyam.
*A Treatise on Heat: M.N. Saha and B.N. Srivastava.

Focus: This course focuses on Employability aligned with CO2, CO3 and CO5.

Course Outcomes

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

CO1	Explain different properties of real gases and their governing equations.
CO2	Understand blackbody spectrum, Wien's displacement law, Rayleigh-Jean's law and Planck's quantum theory
CO3	Explain zeroth, first, second and third law of thermodynamics.
CO4	Obtain relationship between different thermodynamical variables.
CO5	Understand phase transition and Joule Thomson effect.
CO6	Explain Liquefaction of gases, properties of liquid helium, super-fluidity and superconductivity.

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

COs	POs/ PSOs
CO1	PO1, PO4, PO5/PSO1,PSO3
CO2	PO1, PO3,PO4/PSO1,PSO3
CO3	PO1 PO2,PO4,PO5/PSO1,PSO3
CO4	PO1,PO2, PO5,PO6/PSO1,PSO3
CO5	PO1,PO3, PO7/PSO1,PSO3
CO6	PO1,PO3, PO5,PO8/PSO1,PSO3

BPHS1006: ANCILLARY PHYSICS COURSE –II (Optics)

OBJECTIVES: This course is designed to give knowledge of principles of wave optics to graduate students of physics and chemistry. Students will able to understand the basic concepts of Interference, diffraction and polarization.

Credits: 4 **Semester II** **L-T-P: 4-0-0**

Module No.	Content	Teaching Hours (Approx.)
I	**Interference:** Young's experiment, Coherent source, theory of interference fringes, Fresnel biprism, determination of wavelength, Newton's ring, Conditions for sustained interference, Theory of interference, Lloyd's mirror, Interference in parallel and wedge shaped films, Colours of thin film, Newton's rings , Multiple beam interference in parallel film, Fabry-Perot interferometer. **Diffraction I:** Frenel's and Fraunhoffer diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single..	24
II	**Diffraction II:** N-slits(grating), maximum number of order with plane transmission grating, angular half width of principal maxima, Resolving and dispersive power of grating, telescope and Microscope. **Polarization:** Polarized light and its mathematical representation, Production of polarized light by reflection, refraction and scattering. Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light. Optical activity and Fresnel's theory, Biquartz polarimeter. Basic concept of Laser, Eisenstein's coefficients.	24

Reference Books/ Text Books

*1. Physical Optics: B. K. Mathur and T. P. Pandya.
*2. A textbook of Optics: N. Subrahmanyam, Brijlal and M. N. Avadhanulu.
*3. Geometrical and Physical Optics: Longhurst.
*4. Introduction to Modern Optics: G. R. Fowels.
*5. Optics: P. K. Srivastav

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes:

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

CO1	Explain theory of interference.
CO2	Discuss interference through double slit, Fresnel biprism and thin film (Constant and varying thickness) and working of Fabry-Perot interferometer.
CO3	Understand phenomenon of diffraction through single, double and N slits.
CO4	Calculate resolving and dispersive power of grating.
CO5	Understand polarization of light, methods for production of polarized light and types of polarized light.
CO6	Familiar with optical activity, Biquartz polarimeter, Laser and Eisenstein's coefficients.

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, PO5,PO6 /PSO1,PSO3
CO3	PO1,PO3, PO5,PO6/PSO1,PSO3
CO4	PO1,PO3, PO4,PO5/PSO1,PSO4
CO5	PO2,PO3, PO7,PO8/PSO1,PSO3
CO6	PO1,PO2, PO7,PO8/PSO1,PSO4

BPHS0806 : PHYSICS LAB – II

OBJECTIVES: This course is designed to get practical verifications of the laws of physics subjects relating to modern Physics, electronics and optics.

Credits: 02 **Semester II** **L–T–P : 0–0–4**

1. Determination of Stefan's constant.
2. Determination of temperature coefficient of resistance of material of a given coil.
3. Determination of thermal conductivity of a card-board by Lee's disc method.
4. PN junction diode and Zener diode characteristics.
5. To draw the input and output characteristics of a p-n-p transistor.
6. Construction of two-input 'OR' and 'AND' gates using diode logic and preparation of their truth tables.
7. Determination of self inductance of a coil by Anderson's bridge.
8. Determination of focal length of combination of lenses and nodal distance using nodal slide assembly.
9. Determination specific rotation of cane sugar by polarimeter.
10. Determination of wave length of sodium yellow line by Fresnel's biprism.
11. Determination of wavelength of mercury lines by diffraction grating.
12. Determination of wavelength of sodium yellow line by Newton's rings.
13. To determine diameter/thickness of a thin wire by diffraction method.
14. To determine the plank's constant by Wein's radiation formula using an LDR or (photo cell).

Focus: This course focuses on Skill development aligned with all CO's

Course Outcomes

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

CO1	Apply the various procedures and techniques for the experiments
CO2	Use the different measuring devices and meters to record the data with precision
CO3	Apply the mathematical concepts/equations to obtain quantitative results
CO4	Develop basic communication skills through working in groups in performing the laboratory experiments by interpreting the results

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

COs	POs/ PSOs
CO1	PO1,PO3, PO4/PSO1,PSO3
CO2	PO1,PO2, PO5,PO6/PSO1, PSO4
CO3	PO1,PO2, PO3,PO4/PSO2, PSO3
CO4	PO1,PO7/PSO1,PSO4

BPHS0013: BASIC ELECTRONICS

OBJECTIVES: This course is designed to give the knowledge of semiconductors, diodes, transistors, amplifiers, integrated circuits and digital electronics.

Credits: 04 **Semester III** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Semiconductors:** Intrinsic, Extrinsic, P and N type semiconductors. Concept of Energy Levels (in different solids), Fermi Level and Impurity Level. Mobility, Concept of Drift velocity, Conductivity (Temperature Dependence). **Diode**: PN Junction, Potential Barrier Formation, Derivation for Barrier Potential, Barrier Width and Current, Diode Equation, Current Flow Mechanism in Forward and Reverse Biased Diode. Breakdown (Zener and Avalanche). **Diode Applications:** Rectifier Diode, Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Ripple Factor and Efficiency, Zener Diode and Voltage Regulation. Other important diodes (1) LED, (2) Photo diode and (3) Solar Cell). **Transistors:** BJT and its type: n-p-n and p-n-p, I-V characteristics of CB and CE Configurations. Active, Cutoff and Saturation Regions. Current gains α and β. AC and DC Analysis of Transistor: DC Load line and Q-point. Physical Mechanism of Current Flow. Transistor as an Amplifier. Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias.	24
II	**Amplifiers:** Need of Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. RC-coupled amplifier and its frequency response. Direct coupled (DC amplifier), Concept of Feedback in Amplifiers, Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. **Filters:** L, T and Pi networks. Concept of Low pass, High Pass, Band Pass, Band Stop filters, Filter characteristics. **Integrated Circuits:** Introduction to integrated circuits, hybrid & monolithic IC, Classifications of IC (SSI, MSI, LSI, VLSI etc) **Digital Circuits:** Boolean algebra, logic gates, NAND and NOR gates as universal gates. Simplification of Boolean expressions using K- maps. Half and full adders and subtractors.	24

Reference Books/ Text Books

1. Introductory Circuit Analysis, Robert L. Boylestad, Twelfth edition, Pearson, 2012.
2. A Handbook of Electronics, Gupta & Kumar, Pragati Prakashan, Meerut.
3. Electronic Devices and Circuit Theory Introductory Circuit Analysis, Robert L. Boylestad and Louis Nashelsky, Pearson, Tenth Edition, 2007.

Focus: This course focuses on Employability and Skill development aligned with all CO's

Course Outcomes

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

CO1	Understand basics of semiconductors and variation of conductivity with temperature for given semiconductor.
CO2	Explain principle and output characteristics of PN junction diode and its different applications.
CO3	Interpret principle and characteristics of Bipolar Junction Transistor and analyze its AC/DC load line.
CO4	Analyze different feedback/amplifier circuits and compute different relating parameters.
CO5	Analyze different types of filters and their characteristics.
CO6	Familiar with IC technology and its classifications.
CO7	Learn Boolean algebra and design logic circuits.

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

COs	POs/ PSOs
CO1	PO1,PO4,PO7/PSO1,PSO3
CO2	PO1,PO5,PO6/PSO1,PSO4
CO3	PO1,PO2, PO5,PO6/PSO1,PSO3
CO4	PO1,PO4,PO6/PSO1,PSO4
CO5	PO1,PO2, PO5,PO6/PSO1,PSO3
CO6	PO1,PO2, PO3,PO4/PSO1,PSO3
CO7	PO1,PO4, PO5,PO6/PSO1,PSO3

BPHS0014: ELECTRICITY AND MAGNETISM

OBJECTIVES: Course is designed to impart laws of electricity and magnetism to undergraduate students of physics. It will also help them to understand dielectric and magnetic properties of materials.

Credits: 04 **Semester III** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Electric Field and Potential:** Electric Field, Superposition Principal, E. Field due to Charge Distribution: Wire, Ring, Disk. Electric Flux, Gauss's Theorem and its Application. Electric Potential. Electrostatic Energy and Force on Charged Conductor. Electric Dipole: Electric Field and Potential, Force and Torque on Dipole in External Field. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. Capacitance, Energy Stored in Capacitor, Parallel-Plate, Cylindrical and Spherical Capacitor. Dielectric Materials, Capacitor filled with dielectrics. **Dielectric Properties of Matter:** Electric Field in Matter, Polarization (**P**). Electrical Susceptibility and Dielectric Constant. Displacement Vector **D**. Relations between **E**, **P** and **D**. Gauss's Law in dielectrics.	24
II	**Magnetic Field:** Magnetic Field, Magnetic Force, Charge Particle in M. Field, Hall Effect. Biot-Savart's Law and its Applications. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Force and Torque on a Current Loop. Ampere Law and its Applications. **Magnetic Properties of Materials**: Magnetization Vector (**M).** Magnetic Intensity (**H),** Magnetic Susceptibility. Relation between **B, H** and **M**. Diamagnetism, Paramagnetism and Ferromagnetism. BH curve and Hysteresis. **Electromagnetic Induction:** Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy Density of Magnetic Fields. Introduction to Maxwell's Equations. Concept of Displacement current.	24

Reference Books/ Text Books

1. Electricity and Magnetism: Edward M. Purcell
2. Electricity, Magnetism & Electromagnetic Theory: Mahajan & Choudhury
3. Electricity and Magnetism: Chattopadhyay and Rakshit
4. Electricity and Magnetism: R. Murugeshan

Focus: This course focuses on Employability aligned with CO4 and CO6

Course Outcomes

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

CO1	Explain the electric field and potential to analyze the problems based on it.
CO2	Learn understanding of electric dipole and capacitors.
CO3	Understand properties of dielectric materials and Gauss's law in dielectrics.
CO4	Understand the magnetic field and various law based on it to apply in many electrical circuits.
CO5	Understand properties of magnetic materials and analyze hysteresis curve.
CO6	Explain different laws of electromagnetic induction and familiar with Maxwell's equations.

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

COs	POs/ PSOs
CO1	PO1,PO4/PSO1,PSO3
CO2	PO1,PO5,/PSO1,PSO3
CO3	PO1,PO2, PO5,PO6/PSO1,PSO3
CO4	PO1,PO4, PO4,PO7/PSO1,PSO4
CO5	PO1,PO2, PO4,PO5/PSO1,PSO3
CO6	PO1,PO2, PO5,PO6/PSO1,PSO4

BPHS0015: MORDERN PHYSICS

OBJECTIVES: This course is based on laws of modern physics, quantum mechanics and nuclear physics. It will help undergraduate students to understand different quantum mechanical systems and to have knowledge of high energy physics as well.

Credits: 04 **Semester III** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Radiation and its nature:** **Particle properties of waves:** Black body Radiation, Photoelectric effect, Compton effect. **Wave properties of particles:** de Broglie Hypothesis, phase velocity and group velocity, Wave packets, Heisenberg Uncertainty Principle. **Quantum Mechanics** Wave equation, Time independent and time dependent Schrodinger wave equation, Particle in 1D box, Harmonic Oscillator, Linearity and Superposition, Expectation Values, Operators.	24
II	**Nucleus and its interaction:** **Nuclear Structure:** Nuclear composition, Nuclear Physics Size and structure of atomic nucleus, Its relation with atomic weight, Nature of nuclear force, Binding energy, Liquid drop model, Shell model and magic numbers **Radioactivity:** Law of radioactive decay and half-life, Alpha decay, Beta decay- energy released, Gamma ray emission, Fission and fusion, Classification of Elementary Particles	24

Reference Books/ Text Books

1. Concepts of Modern Physics --- Arthur Beiser, McGraw-Hill.
2. Modern Physics --- Murugesan and Sivaprasad (S. Chand Higher Academics)

Focus: This course focuses on Employability aligned with CO2, CO4 and CO5

Course Outcomes

3. After the completion of this course, students will be able to:

CO1	Understand experiments confirming and wave nature of radiation.
CO2	Derive Time dependent and time independent Schrodinger equation and apply them to solve various quantum problems
CO3	Explain linearity, superposition, expectation Values and operators for quantum systems.
CO4	Explain the nuclear structure by various nuclear models and calculate the nuclear energy, magic numbers.
CO5	Discuss radioactivity, various nuclear processes and different elementary particles

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,PO3, PO5,PO6/PSO1,PSO3
CO3	PO1,PO2, PO7,PO8/PSO1,PSO4
CO4	PO1,PO2, PO4,PO5/PSO1,PSO3
CO5	PO1,PO2, PO5,PO6,/PSO1,PSO4

BPHS0016: ELEMENTARY STATISTICAL MECHANICS AND THERMAL PHYSICS

OBJECTIVES: This course is designed to give knowledge of different thermodynamical systems including phase transitions, liquid helium etc. It will also impart fundamentals of statistical mechanics as well.

Credits: 04 **Semester III** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	Third Law of thermodynamics, Nernst heat theorem, Criterion of equilibrium of a system, Isolated System, System in contact with constant temperature reservoir, System in contact with constant temperature and pressure reservoir, Phase transition, Coexistence of phases, Triple point, Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for van der Waals gas, Liquidification of gases, Properties of liquid helium, Introduction to super-fluidity and superconductivity.	24
II	Probability, Some probability considerations (Tossing of coins), Combination possessing maximum and minimum probability, Distribution of n molecules in two halves of a box, Basic idea of phase-space, Idea of Macro states and Microstates, Constraints, Accessible and inaccessible states, Probability distribution and its narrowing with increase in number of particles, Thermodynamic probability, Principle of equal a priori probability, Distribution of particles with a given total energy into a discrete set of energy states.	24

Reference Books/ Text Books

1. Thermodynamics and Statistical Physics: J.P. Agrawal and Satya Prakash.
2. Heat Thermodynamics and Statistical Physics: Brij Lan, N. Subrahmanyam and P.S. Hemne.
3. Introduction to Statistical Mechanics: B B Laud.
4. Statistical Physics: F Reif.
5. Statistical Physics: K Haung.

Focus: This course focuses on Employability aligned with CO5 and CO6

Course Outcomes

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

CO1	Understand the concepts of Third law of thermodynamics and Joule Thomson Effect.
CO2	Obtain thermodynamic equations for van der Waals gas.
CO3	Explain Liquidification of gases, properties of liquid helium, super-fluidity and superconductivity.
CO4	Learn probability and some probable considerations.
CO5	Explain phase-space, Macro states and Microstates, Constraints, Accessible and inaccessible states.
CO6	Discuss distribution of particles with a given total energy into a discrete set of energy states

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

COs	POs/ PSOs
CO1	PO1,PO2, PO5,PO6/PSO1,PSO3
CO2	PO1,PO3, PO4,PO5/PSO1,PSO2, PSO3
CO3	PO1,PO2, PO7,PO8/PSO1,PSO3
CO4	PO1,PO2, PO5,PO6/PSO1,PSO3
CO5	PO1,PO2, PO3,PO4/PSO1,PSO2, PSO3
CO6	PO1,PO2, PO5,PO6/PSO1,PSO3

BPHS0017: ELEMENTARY SOLID STATE PHYSICS

OBJECTIVES: This elementary course of solid state physics gives the basic information about the state of matters and the various applications of the different materials in solid state devices and their applications.

Credits: 04 **Semester IV** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	Crystal Structure: Introduction, Solids: Amorphous and Crystalline Materials, Crystal lattice and translation vectors, unit cell, Basis, Symmetry operations, Lattice directions and planes, Bravais lattices, Miller indices for direction and planes, Simple crystal structures, Close packed structures. Bonding of Solids: Introduction, Concept of inter-atomic forces, Cohesive energy and types of bonding, Primary bonds (ionic bonds, Covalent bond and metallic bond), secondary bonds (Vander waals bond and hydrogen bonds), Lennard Jones potential. Structure and Symmetry: Diffraction of X-rays by crystals, Laue equations and Braggs law.	24
II	Band Theory of Solids, Insulators, Conductors, Semiconductor (P and N type). Conductivity of Semiconductor, mobility, Hall Effect & Hall coefficient. Superconductivity: Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London"s Equation and Penetration Depth. Magnetic Properties of Matter: Dia-, Para-, and Ferromagnetic Materials. Langevin Theory of diamagnetism, Ferromagnetism and Discussion of B-H Curve. Hysteresis and Energy Loss. Dielectric Properties of Materials: Polarization. Types of Polarization. Relation between electric field, polarization and D.	24

Reference Books/ Text Books

1. 1.Solid State Physics --- S.O Pillai.
2. 2. Solid State Physics ----- Gupta Kumar
3. Fundamental of Solid-State Physics ---- Sexena, Gupta, Sexena
4. Solid state Physics ----- Deccar
5. Solid State Physics ----- R.K. puri, V.K. Babbar; Modern Physics by R.Murugesham
6. Introduction to Solid State Physics--- Charles Kittel, 8th Ed.

Focus: This course focuses on Employability aligned with CO1,CO2 and CO6

Course Outcomes

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

CO1	Understand the basics of crystal structure and their different types.
CO2	Familiar with different types of bonding in solids and concept of cohesive energy.
CO3	Interpret about the symmetry of crystal structures using X ray diffraction method.
CO4	Familiar with different types of solids and their characteristics.
CO5	Discuss superconductors and their properties.
CO6	Explain the magnetic and dielectric properties of different solids.

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

COs	POs/ PSOs
CO1	PO2,PO3,PO5,PO6/PSO1, PSO2,PSO3
CO2	PO2,PO3,PO4,PO6/PSO1,PSO4
CO3	PO1,PO3,PO5,PO7/PSO1,PSO3
CO4	PO2,PO3,PO5, PO6/PSO1, PSO2,PSO3
CO5	PO1,PO2, PO4,PO5/PSO1,PSO3
CO6	PO2,PO3,PO7,PO8/PSO1,PSO2,PSO3

BPHS0018: ELEMENTARY QUANTUM MECHANICS

OBJECTIVES: The origin of quantum mechanics overcomes the shortcomings of classical mechanics and provides the new mathematical approach to solve the physical problems of different branches of science and engineering.

Credits: 04 **Semester IV** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Origins of Quantum Mechanics:** In adequacy of classical mechanics, development of old quantum theory, particle aspects of radiations, black body radiation, quantum photoelectric effect, dual nature of light and matter, de-broglie's hypothesis, phase velocity and group velocity, wave packets, Heisenberg's uncertainty principles and its application.	24
II	**Equation of motion of matter waves:** Schrodinger equation of a free particle, time independent and time dependent Schrodinger equation, physical interpretation of wave function, normalized and orthogonal wave function, exception values of dynamical quantities, probability current density, solution of Schrodinger equation, physical application of Schrodinger equation to one dimensional problems, particle in a box.	24

Reference Books/ Text Books

1. Quantum Mechanics – Satya Prakash
2. Introduction to Quantum Mechanics by David J. Griffiths
   Quantum Mechanics by Ajoy Ghatak and S. Lognathan

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes

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

CO1	Understand inadequacy of classical mechanics leading to origin of quantum mechanics.
CO2	Explain particle aspects of radiations.
CO3	Derive Schrödinger equations for matter waves.
CO4	Apply Schrödinger equations to deal with different physical quantum systems.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO4,PO6/PSO1,PSO4
CO2	PO2,PO2, PO3,PO5/PSO1,PSO3
CO3	PO1,PO2,PO4,PO5/PSO1,PSO2,PSO4
CO4	PO2,PO3,PO5,PO7/PSO1,PSO2,PSO3

BPHS0019: ATOMIC PHYSICS

OBJECTIVES: The objective of offering this course to the UG Students to make them aware about the atomic spectra of solids and generation and application of laser beam.

Credits: 04 **Semester IV** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Atomic Physics:** J.J. Thomson atomic model, Rutherford scattering: Rutherford atomic model, Bohr's atomic model and its limitations, Somerfield relativistic atomic model, effect of finite nuclear mass in relation to Redburg's constant, Idea of discrete energy levels and electron spin: Frans and Hertz and Strarm – Geolack experiments, Quantum numbers and thus significance, paul's exclusion principle, concept of atomic orbiters, Hunde rule. **One and two electron atoms:** Orbital magnetic moment, orbital, spin and total angular momenta, Larimore procession, vector atomic model, electronic configuration and atomic states, Spin orbit interaction, fine structure, selection rules, intensity of spectral line, LS and JJ coupling scheme in two volume electron atoms, normal and inverted doublet spectra of Helium, Sodium and Mercury, Linde 'g' factor, Zeeman effect (normal), Stark effect.	24
II	**X-Ray Spectroscopy:** Production of X-Rays and their properties, continuous X-Ray spectrum and its dependence on voltage, dune and hunt's law, characteristic X-Rays, Moseley's law, doublet structure and scrumming parameter in X-Ray Spectra, X-Ray absorption spectra. **Laser:** Spontaneous and stimulated expression, Einstein A and B Coefficients and relation between them, Metastable state, population inversion, pumping and its types, three and four state lasers: Ruby Laser, He-Ne Laser, He-Ne Laser.	24

Reference Books/ Text Books

1. Atomic Physics by J.B. Rajam, S.Chand & Company Limited.
2. Quantum Physics of Atoms, Molecules, Solves, Nuclie and particles: Robert Eisburg and Robert Resnick.
3. Physics of atoms and molecules, Bransden and Joshin Pearson.
4. Atom, Laser and Spectroscopy, S.N. Thakur and D.K. Rai, Prentice Hall of India.
5. Nuclear Physics by D C Tayal, Himalyan Publications.

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes

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

CO1	Understand basic models of relating to atomic structure.
CO2	Explain electronic configuration, states and fine structure of atoms.
CO3	Familiar with Zeeman and stark effects.
CO4	Discuss properties and applications of X ray in field of spectroscopy.
CO5	Understand working principle of different Lasers and their applications.

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

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

BPHS0020: ELEMENTS OF NUCLEAR PHYSICS

OBJECTIVES: This course describes the four fundamental courses in nature and their existence and application in different fields of science.

Credits: 04 **Semester IV** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**General Properties of Nucleus and Nuclear Models :** Introduction to the nucleus and a brief survey of general Properties of the Nucleus (size, internal structure, charges, Spin and Magnetic moment, Binding energy, Nucleon emission, separation energy, Properties of nucleon-nucleon interaction). Fermi gas model, Liquid drop model and bethe Weiszacher mass formula, Single particle shell model (only the level scheme in the context of reproduction of magic numbers). **Nuclear Forces:** Nature, Range, Saturation phenomena and Exchange forces, Deutron ground state properties (No derivation). **Nuclear Reactions:** Nuclear reactions and their conservation laws, Theory of fission (Qualitative), Nuclear reactors and Nuclear fusion	24
II	**Natural Radioactivity**: Fundamental laws of radioactivity, Soddy-Fajan 's displacement law and law of radioactive disintegration, Basic ideas about decay, Alpha decay and its energy spectrum, Q-v alu e, Gamo w's theory of al ph a d ecay (no derivation), Beta decay , Need for neutrinos, Q-value for beta decay, Gamma decay. **Accelerators and detectors**: Vande Graff, Cyclotron and Synchrotron, Interaction of charged particles and gamma rays with matter (qualitative), GM counter, Scintillation counter and neutron detectors. **Elementary Particles:** Basic classification based on rest mass, Spin and half life, particle interactions (gravitational, Electromagnetic, week and strong Interactions), Quantum numbers.	24

Reference Books/ Text Books

1. Introductory Nuclear Physics: S. S. M. Wong. 2. Nuclear Physics: V. Devanathan.
2. Concepts of Nuclear Physics: B. L. Cohen.
3. Fundamentals of Nuclear Physics: B. B. Srivastava.
4. Introduction to Nuclear Physics: H. A. Enge.
5. Nuclear Physics: S. N. Ghoshal.

Focus: This course focuses on Employability aligned with CO1, CO2 and CO4

Course Outcomes

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

CO1	Understand properties of nucleus and different nuclear models .
CO2	Familiar with different types of nuclear forces and their interactions.
CO3	Familiar with different nuclear reactors and their applications.
CO4	Learn principle of radioactivity and its implications.
CO5	Understand the working principle of different accelerators and detectors.
CO6	Explain different types of interaction of elementary particles.

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	PO2,PO3, PO4,PO5/PSO1,PSO3
CO3	PO2,PO3, PO5,PO6/PSO1,PSO4
CO4	PO2,PO3, PO4,PO5/PSO1,PSO3
CO5	PO1,PO2, PO3,PO5/PSO1,PSO2
CO6	PO2,PO3, PO6,PO7/PSO1,PSO2, PSO3

BCHC 1002: GENERAL CHEMISTYRY - I

Objective: *This course aims to expose the students to the various concepts and applications of general chemistry and general science.*

Credits: 04 **Semester I** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Atomic Theory – Structure of an Atom:** The concept of atoms and molecules; Earlier model (Rutherford model, Dalton's atomic theory, Bohr's Theory) **Acids, Base, and Salts,** **Mole concept**: Expressing concentration of solution (Molarity, Normality, Formality, Molality, mole fraction etc. **Chemical reactions:** Types & balancing of chemical equations involving common oxidation-reduction, neutralization and displacement reactions. **Atomic Structure** Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation (no derivation), significance of Ψ and Ψ^2, quantum numbers, shapes of s, p, d orbitals. Aufbau principle, Hund's multiplicity rule and Pauli exclusion principle. Electronic configurations of the elements and ions. **Periodic Properties:** Classification of elements on the basis of s, p, d, f subshells. Periodic properties- atomic and ionic radii, ionization energy, electron affinity and electro negativity-definition-trends in periodic table and factors affecting them.	24
II	**Valuation of Analytical Data**: Significant figures, determinant and non-determinant errors, absolute and relative errors, terms of mean and median, precision and accuracy in chemical analysis, determining accuracy of methods, standard deviation, numerical problems related to evaluation of analytical data. **Energetics**: -First law of thermodynamics, Internal energy, Enthalpy, Heat of reaction, heat of formation, heat of combustion, heat of neutralization, heat of fusion, heat of vaporization. Hess's law of heat summation. Second law of thermodynamics, Entropy, Free energy, Criterion of spontaneity. **Chemical Bonding–I:** Types of bonding: Ionic bond, Covalent Bond, Co-ordinate bond. Hydrogen bond. Directional characteristics of covalent bond. Lattice energy and solvation energy and solubility of ionic solids. Born-Haber cycle. Fajan's rule. Percentage ionic character from dipole moment and electronegativity difference. Metallic bond- free electron model, valence bond and band theories.	24

	Valence bond theory and its limitations. Molecular orbital theory and its limitations. VSEPR Theory: various types of hybridization and shapes of simple inorganic molecules and ions (BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7, H_2O, NH_3, XeF_2, XeF_4, BF_4^-, PF_6^-, $SnCl_6^{2-}$). **Colloidal State:** Definition and classification of colloids. Difference between lyophobic and lyophilic sols. Kinetic, optical and electrical properties of sols, stability of colloids, protective action of colloids-gold number, coagulation of colloid-Hardy-Schulze law. Liquids in liquids (emulsions): Types of emulsions, preparation and Emulsifiers. Liquids in solids, (gels) classification, preparation and properties. General applications of colloids. Colloidal electrolytes.	

Reference/ Text Books:

1. Ebbing, D. D.; Gammon, S. D. General Chemistry, 7th ed.; Houghton Mifflin (Trade): Boston, MA, 2001.
2. Barone, S. General Chemistry; Blackwell Science: Oxford, England, 2000.
3. Hill, J. W.; Petrucci, R. H. General Chemistry: An Integrated Approach, 6th ed.; Prentice Hall: Old Tappan, NJ, 1996.
4. McMurry, J. E.; Fay, R. C. General Chemistry: Atoms First: United States Edition; Pearson: Upper Saddle River, NJ, 2009.
5. Umland, J. B.; Bellama, J. M. General Chemistry, 3rd ed.; Brooks/Cole: Florence, KY, 1999.
6. Brady, J. E. General Chemistry: Principles and Structure, 4th ed.; John Wiley & Sons, 1986.
7. Malone, L. J. Basic Concepts of Chemistry, 7th ed.; John Wiley & Sons: Nashville, TN, 2004.
8. Dingle, C. F.; etc. Basic Chemistry, 3rd ed.; Hodder & Stoughton: London, England, 1971.

Focus: This course focuses on Employability aligned with CO3, CO5, CO8

Course Outcome:

After studying this course students will able to:

- CO1: Prepare solutions in different case.
- CO2: Balance chemical equation.
- CO3: Write electronic configuration of various elements and their ions
- CO4: Understanding variation of different parameters in periodic table.
- CO5: Conceptualize structure and bonding
- CO6: Predict type of Hybridization and shape inorganic molecules and ions
- CO7: Evaluate the analytical data
- CO8: Apply Law's of thermodynamics to calculate heat of reaction, heat of formation etc.
- CO9: Classify and identify colloids and their properties.

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

COs	**POs/PSOs**
CO1	PO2/PSO3
CO2	PO1, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO5,PO8/PSO1
CO5	PO1, PO4, PO7/PSO2
CO6	PO9,PO11/PSO4
CO7	PO4,PO8/PSO1
CO8	PO4,P10/PSO3
CO9	PO4,PO8/PSO4

BCHC 1901: CHEMISTRY LAB - 1

Objective: This course aims to expose the students to the experimental aspects of standard solution, its preparation and also identification of radicals.

Credits: 02 **Semester I** **L–T–P : 0–0–4**

1. **A.** Prepare a solution N/10 HCl Solution.
   B. Standardize the prepared HCl solution by titrating it against N/20 NaOH solution using phenolphthalein as an internal indicator.
2. **A.** Prepare a standard solution of ferrous ammonium sulphate solution of strength N/30 approximately.
   B. Find out the strength of given ferrous ammonium sulphate solution by titrating it against $KMnO_4$ solution as an intermediate solution.
3. **A.** Preparation of Hypo solution
   B. Prepare a standard solution of copper sulphate of strength N/40 approximately.
   C. Find out the strength of given copper sulphate solution iodometerically by titrating it against Hypo solution as an intermediate solution using starch as an internal indicator.
4. Analyze the following acid radicals in the given salts:
   i) Cl^-, Br^-, I^- (combination),
   ii) NO_3^-, NO_2^- (combination),
   iii) BO_3^{3-}, PO_4^{3-} and removal of interfering radical.
5. Analyze the following acid radicals in the given salts:
   i) CO_3^{2-} , SO_3^{2-} (combination),
   ii) SO_4^{2-}, SO_3^{2-}, S^{2-} (combination),
   iii) CH_3COO^-, NO_2^-, F^-, $C_2O_4^{2-}$ and removal of interfering radical.
6. Analyze the following basic radicals in the given salts: Hg_2^{2+}, Ag^+, Pb^{2+}, Hg^{2+}, Cu^{2+},Cd^{2+}, Bi^{3+}
7. Analyze the following basic radicals in the given salts: As^{3+}, Sb^{3+}, Sn^{2+}, Sn^{4+}, Al^{3+}, Fe^{3+}, Cr^{3+}
8. Analyze the following basic radicals in the given salts: Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}
9. Analyze the following basic radicals in the given salts: Ba^{2+}, Sr^{2+},Ca^{2+}, Mg^{2+}, NH_4^+
10. Analyze the given inorganic mixture containing two acidic and two basic radicals.
11. To determine the relative viscosity of a given liquid with respect to water at room temperature by Ostwald`s viscometer.

Note:

- The mixture may contain more than one basic radicals of same group.
- If the mixture contains any interfering radical then basic radicals of beyond second group may be given.
  The mixture will not contain more than one interfering radical, if present.

Reference/text books:

1. Turpin, G. S. Practical Inorganic Chemistry; General Books, 2009.
2. Vogel, A. I. Textbook of Quantitative Inorganic Analysis, 4th ed.; Longman: London, England, 1978.
3. Vogel, A. I. Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rd ed.; Prentice Hall Press: London, England, 1961.
4. Ahluwalia V K, Dhingra, S., College Practical Chemistry, UniversityPress, Hydrabad, 2015.
5. James, A. M.; Prichard, F. E. Practical Physical Chemistry, 3rd ed.; Prentice Hall Press: London, England, 1974.
6. Firth, J. B. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
7. Findlay, A. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
8. Viswanathan, B. Practical Physical Chemistry; Viva Books: New Delhi, India, 2012.
9. Maity, S. K.; Ghosh, N. K. Physical Chemistry Practical; New Central Book Agency: Delhi, India, 2012.

Focus: This course focuses on Skill development aligned with all CO's

Outcome:

After studying this course students will able to:

CO1. Prepare standard and working solutions used in an experiment.

CO2. Analyze acid and basic radicals individually or in mixture.

CO3. Estimate the concentration of ferrous and copper ions from given sample.

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

COs	**POs/PSOs**
CO1	PO4/PSO2
CO2	PO3, PO6/PSO6
CO3	PO1, PO2/PSO5

BCHC 1004: GENERAL CHEMISTRY-II

Objective: This course aims to expose the students to the general aspects of different branches of chemistry which includes nuclear, metallurgy, fuels, water treatment, gaseous acid and bases, chemical equilibrium.

Credits: 04 **Semester II** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**IUPAC** Nomenclature of simple Organic (aliphatic and aromatic) Compounds **Organic Reaction Mechanisms I: Substitution Reactions** (Nucleophilic SN1 and SN2), free radical and electrophilic), addition reactions (electrophilic and free radical) and their mechanisms. Energy profile diagrams and transition state (general considerations). Elimination Reactions, Elimination versus substitution reactions. **Nuclear chemistry:-**Radioactivity: Types and properties of radiations (α, β, and γ rays), Fajan's Soddy group displacement law, rate of radioactivity decay, half life and average life. Artificial radioactivity, stability of nuclei with respect to proton-neutron ratio. Nuclear fusion & nuclear fission. Packing fraction. Carbon dating. Applications of radioactivity. Isotopes and Isobar. **Gaseous State:** Gas laws. Velocity of Gas, average velocity, root mean square velocity, and most probable velocity, Postulates of kinetic theory of gases, derivation of kinetic gas equation and explanation of gas laws from it, deviation of real gases from ideal behavior, van der Waals equation of states, isotherms of CO_2, critical constants and their calculations.	16
II	**Stereochemistry of Organic Compounds-I** Concept of isomerism. Types of isomerism, Configurational isomerism : Optical isomerism-elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral molecules , diastereomers, threo and erythro diastereomers, meso compounds, Resolution of enantiomers, inversion, retention and racemisation. **Electrochemistry I:** Electrochemical Cells: Galvanic cells, reversible and irreversible cells, experimental determination of emf of a cell. Relation between free energy and emf of reversible cell. Standard hydrogen electrode. Single electrode potential (derivation of Nernst equation) and its measurement. Standard electrode potential. Calculation of emf of reversible cell from electrode potentials. Types of reversible electrodes, Concentration cells.	16

	Chemical equilibrium: Law of mass action, equilibrium constant, relation between K*p* & K*c*, Le Chatelier's principle (effect of concentration, temperature and pressure on equilibrium) **Acids and Bases:** Arrhenius, Brönsted-Lowry, Lewis acid-base concept, Pearson, HSAB concept.	

Reference/ Text Books:

1. Ebbing, D. D.; Gammon, S. D. General Chemistry, 7th ed.; Houghton Mifflin (Trade): Boston, MA, 2001.
2. Barone, S. General Chemistry; Blackwell Science: Oxford, England, 2000.
3. Hill, J. W.; Petrucci, R. H. General Chemistry: An Integrated Approach, 6th ed.; Prentice Hall: Old Tappan, NJ, 1996.
4. McMurry, J. E.; Fay, R. C. General Chemistry: Atoms First: United States Edition; Pearson: Upper Saddle River, NJ, 2009.
5. Umland, J. B.; Bellama, J. M. General Chemistry, 3rd ed.; Brooks/Cole: Florence, KY, 1999.
6. Brady, J. E. General Chemistry: Principles and Structure, 4th ed.; John Wiley & Sons, 1986.
7. Malone, L. J. Basic Concepts of Chemistry, 7th ed.; John Wiley & Sons: Nashville, TN, 2004.
8. Dingle, C. F.; etc. Basic Chemistry, 3rd ed.; Hodder & Stoughton: London, England, 1971.
9. Mallick, A. Engineering Chemistry; Anshan: Royal Tunbridge Wells, England, 2009.
10. Breck, W. G.; etc.; Brown, R. J. C. Chemistry for Science and Engineering; McGraw-Hill: New York, NY, 1981.

Focus: This course focuses on Employability aligned with CO1, CO2 and CO7

Outcome:

After studying this course students will able to:

CO1: Assign the Nomenclature of simple Organic (aliphatic and aromatic) Compounds
CO2: Propose the mechanism for substitution, elimination and addition reactions.
CO3: Apply metallurgical principle in extraction of metals
CO4: Predict the nature of solution, acidic, basic, neutral
CO5: Derive average velocity, root mean square velocity, and most probable velocity
CO6: Evaluate packing fraction and proton-neutron ratio
CO7: Apply Fajan's Soddy group displacement law to identify product in a radioactive change.
CO8: Differentiate strong and week acids

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3,PO9/PSO2
CO8	PO1, PO3/PSO4

BCHC 1902: CHEMISTRY LAB-II

Objective: This course aims to expose the students to achieve practical expertise on various experiments.

Credits: 02 **Semester II** **L–T–P : 0–0–4**

1. i) To prepare a solution of N/20 potassium dichromate.
   ii) Find out the strength of given $K_2Cr_2O_7$ solution by titrating it against ferrous ammonium sulphate solution as standard solution and using potassium ferricyanide as an external indicator.
2. i) Prepare a standard solution of potassium dichromate of strength N/30 approximately.
   ii) Find out the strength of given potassium dichromate solution iodometrically by titrating it against hypo solution as an intermediate solution using starch as an internal indicator.
3. To prepare Chrome alum $K_2SO_4Cr_2(SO_4)_3.24H_2O$.
4. To prepare Ferrous ammonium sulphate (Mohr`s salt) $FeSO_4.(NH_4)_2SO_4.\ 6H_2O$.
5. To prepare Tetra ammine copper (II) sulphatemonohadrate $[Cu(NH_3)_4]SO_4.H_2O$.
6. To separate the metal ions by paper chromatography.
7. Identification of functional group in a given organic compound. (C=C, CHO, R-CO-R, -COOH, ester).
8. Identification of functional group in a given organic compound. (Phenol, alcohol, carbohydrate, $-NH_2$, $-NO_2$, amide).
9. To determine the relative surface tension of a given liquid with respect to water at room temperature by stalagmometer.

Reference/text books:

1. Turpin, G. S. Practical Inorganic Chemistry; General Books, 2009.
2. Vogel, A. I. Textbook of Quantitative Inorganic Analysis, 4th ed.; Longman: London, England, 1978.
3. Vogel, A. I. Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rd ed.; Prentice Hall Press: London, England, 1961.
4. Ahluwalia V K, Dhingra, S., College Practical Chemistry, UniversityPress, Hydrabad, 2015.
5. James, A. M.; Prichard, F. E. Practical Physical Chemistry, 3rd ed.; Prentice Hall Press: London, England, 1974.
6. Firth, J. B. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
7. Findlay, A. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
8. Viswanathan, B. Practical Physical Chemistry; Viva Books: New Delhi, India, 2012.
9. Maity, S. K.; Ghosh, N. K. Physical Chemistry Practical; New Central Book Agency: Delhi, India, 2012.

Focus: This course focuses on Skill development aligned with all CO's

Course Outcome:

After studying this course students will able to:

CO1: Prepare standard and working solutions used in an experiment.
CO2: Synthesize Chrome alum, Ferrous ammonium sulphate and Tetra ammine copper(II) sulphatemonohadrate.
CO3: Analyze acid and basic radicals individually or in mixture.
CO4: Separate the metal ions by paper chromatography
CO5: Identify functional group in a given organic compound
CO6: Determine the relative surface tension of a given liquid with respect to water at room temperature by stalagmometer.
CO7: Estimate the chloride ion content and hardness in a given sample of water.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO5,PO7/PSO1

BMAS 0502: ALGEBRA AND CALCULUS

Course Objectives: To make the students understand the concepts of algebra and calculus by giving more emphasis to their applications in the field of Physics.

Credits: 03 **Semester I** **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Matrices**: Rank by Echelon form, Solution of system of linear equations by elementary transformations and Cramer's rule, Complex matrices, Eigen values and Eigen vectors, Cayley-Hamilton theorem, Model matrix. **Differential Calculus**: Successive differentiation, calculation of n^{th} derivative, Leibnitz theorem, Partial differentiation, Euler's theorem.	20
II	Composite functions, Total derivative, Jacobian and its properties, Expansion of functions of one and two variables. **Integral Calculus**: Beta and Gamma functions, Double and Triple integrals, Change of order, Change of variables. **Vector Calculus:** Gradient, Divergence and Curl, Green's theorem, Gauss' divergence theorem and Stoke's theorem (without proof).	20

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, New Delhi, 2002.

Reference Books:

- W. E. Boyce and R. D. Prima, Elementary Differential Equations, John Wiley & Sons, 2009.
- G. B. Thomas and R. Finney, Calculus & Analytic geometry, Addison Wesley, USA, 1995.

Reference Books:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.

Focus: This course focuses on Skill development aligned with all CO's

Course Outcomes:

After studying these topics, the student will be able to

- Understand partial differentiation and its applications
- Find rank of a matrix and its applications in solving systems of linear equations
- Evaluate double, triple integrals and study their applications

- Find the gradient of a scalar point function and divergence, curl of a vector field

BMAS 0503: APPLIED MATHEMATICS AND STATISTICS

Course Objectives: To make the students understand the concepts of ordinary differential equations, statistics and numerical methods by giving more emphasis to their applications in chemistry.

Credits: 04 **Semester II** **L–T–P: 3–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Ordinary Differential Equations (ODEs):** Solution of ODEs of I order and I degree, Solution of n^{th} order linear differential equations with constant coefficients, Euler-Cauchy Equations, Simultaneous differential equations. **Numerical Methods:** Errors & its types, Iteration and Newton Raphson method, Finite differences, Missing term technique.	20
II	Interpolation by Newton's forward and divided difference formulae, Numerical integration by trapezoidal and Simpson's rules, Numerical solution of I order ODE by Runge-Kutta IV order method. **Statistics:** Measures of central tendency and Dispersion, Correlation and Regression, Fitting of straight line by method of least squares, Binomial and Poisson distributions, Statistical hypotheses, Level of significance, Chi– square test.	20

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Statistics, Sultan Chand & Sons, Delhi, 2014.
- M. Goyal, Computer Based Numerical and Statistical Techniques, University Science Press, Delhi, 2017.

Focus: This course focuses on Skill development aligned with all CO's

Course Outcomes:

After studying these topics, the student will be able to

- Solve the ordinary differential equations and know their applications in chemistry
- Apply numerical techniques for numerical differentiation and integration
- Understand the probability distributions
- Test the hypothesis by Chi-square test

Reference Books:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.

BELH 0007: English Language Skills - I

Course Objectives: Keeping in mind the diverse set of students (as far as their mother tongues are concerned) in the undergraduate programmes of the University, this course aims to

- help students acquire the four basic language skills: listening, speaking, reading and writing,
- introduce fundamentals of English grammar for its proper usage,
- facilitate the learners to think logically, evaluate judiciously and express themselves effectively in spoken as well as written English,
- enhance appropriate vocabulary, and to
- enable them to attain standard Indian English pronunciation as well as provide them practice of speaking in stress free environment.

Credits: 03 **Semester: I** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Grammar**: Parts of Speech: Noun, Pronoun, Adjective, Adverb, Verb Sentence **Vocabulary**: Word Formation using prefixes & suffixes **Reading:** Study of Text: "The Eyes are not Here" by Ruskin Bond; **Speaking**: Describing self, persons, places & objects **Vocabulary**: Words often confused **Writing:** Developing a story from given clues	**21**
II	**Grammar**: Tense; Prepositions, Articles, Subject – Verb Agreement **Communication**: What is communication? Process of communication; Types and barriers of Communication **Error corrections**: Related to the grammar topics covered in module I & II. **Vocabulary**: Synonyms & Antonyms **Study of Text**: "After Twenty Years" by O' Henry. **Speaking:** Role Play and Small Talk**,** Speaking on need based topics like talking about habits, daily routine, likes and dislikes.	**24**

Prescribed Text**: *An Anthology of Short stories,* Ed. RP Singh, Oxford University Press, New Delhi**

References:

Wren & Martin, ***High School English Grammar and Composition***, **S.Chand & Co. Ltd., New Delhi.**
Allen, W., *Living English Structure*, Pearson Education, New Delhi.
***Collins English Dictionary*, Harper Collins Publication Ltd.**
***Longman Dictionary of Contemporary English*, Pearson Longman, England.**
Murphy, Raymond, *Intermediate English Grammar,* Cambridge University Press.
Norman Lewis, *Word Power Made Easy*, Goyal Publications & Distributers, Delhi.
Mohan, Krishan & N.P. Singh, *Speaking English Effectively*, Macmillan India Ltd., New Delhi.

Audio-Visual Material: **Material available in the language Lab.**

Focus: This course focuses on Skill development aligned with all CO's

Course Outcomes: After the completion of the course, the participants should be able to

1. speak and express themselves effectively and confidently in groups and communicate in real life situations,
2. read a text to comprehend, analyze and evaluate it effectively in both written as well as spoken English,
3. enrich their vocabulary and apply it appropriately in the required context,
4. state their view point with confidently, and to
5. **understand good communication strategies.**

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO6, PO7, PO9
CO2	PO6, PO7, PO9
CO3	PO6, PO7, PO9
CO4	PO6, PO7, PO9
CO5	PO6, PO7, PO9

BELH 0008: English Language Skills-II

Focus: This course focuses on Skill development aligned with all CO's

Course Objectives: The objectives of this course are to:

- enhance students' proficiency in the four basic language skills: listening, peaking reading and writing,
- enable them to classify, form and construct a variety of sentences as per the requirement of context,
- make students understand basic grammar items for their proper usage,
- facilitate the students to think critically, organize their thoughts systematically, assess their observation prudently and present themselves effectively in spoken as well as written English,
- increase vocabulary and its usage in speaking and writing, and to
- familiarize the learners with nuances of writing and enable them to write a good piece using correct format, language and tone.

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

Module No.	Content	Teaching Hours
I	**Grammar**: Active & Passive Voice Question Tags Modal Auxiliaries **Vocabulary**: One Word Substitution, Homonyms & Homophones **Writing:** Description of Technical Objects Paragraph writing – Principles & Development; writing a paragraph on a given topic **Study of Text**: "Science and Human Life" by JBS Haldane **Speaking:** Group Discussion; Words commonly mispronounced	**18**
II	**Grammar**: Conjunctions, Conditionals, Error Correction **r**elated to the grammar topics covered in modules I & II **Listening**: Importance of listening, Listening & Hearing, Active & Passive Listening and Barriers **Vocabulary**: Technical Vocabulary, Situational Vocabulary, Phrasal Verbs **Writing**: Formal Applications & Letter to Editor **Study of Text**: "The Heritage of India" by A.L. Basham **Speaking:** Power Point Presentation	**18**

Prescribed Text**:** ***An Anthology of English Essay,*** **Ed. RP Singh, Oxford University Press, New Delhi**
References:
Wren & Martin, ***High School English Grammar and Composition***, **S.Chand & Co. Ltd., New Delhi.**
Allen, W., ***Living English Structure*****, Pearson Education, New Delhi**
Collins English Dictionary**, Harper Collins Publication Ltd.**
Longman Dictionary of Contemporary English**, Pearson Longman, England.**
Murphy, Raymond, ***Intermediate English Grammar,*** **Cambridge University Press.**
Norman Lewis, ***Word Power Made Easy*****, Goyal Publications & Distributers, Delhi.**
Mohan, Krishan & N.P. Singh, ***Speaking English Effectively*****, Macmillan India Ltd., New Delhi.**
Audio-Visual Material: **Material available in the language Lab.**

Focus: This course focuses on Skill development aligned with all CO's

Course Outcomes**: After the completion of this course, the students should be able to**

1. **acquire correct listening and speaking strategies as well as appropriate reading and writing skills,**
2. **participate in formal or informal discussions or conversations using appropriate vocabulary and expression,**
3. **convey their thoughts and views properly while writing and speaking,**
4. **evaluate, analyze, comprehend and discuss a text and other reading material, and to**
5. **acquire general proficiency in written and spoken English.**

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Pos
CO1	PO6, PO7, PO9
CO2	PO6, PO7, PO9
CO3	PO6, PO7, PO9
CO4	PO6, PO7, PO9
CO5	PO6, PO7, PO9

List of Experiments B.Sc. IInd Year (IIIrd Sem.)

Electronics ,Code-BPHS0807

1. To study half wave & full wave rectifier.
2. To study Bridge wave rectifier.
3. To study and plot VI characteristic of semiconductor diode.
4. To study and plot VI characteristic of Zener diode.
5. To study RC, LC passive filter. (ETB-77)
6. To study RC phase shift oscillator of phase advanced type.
7. To study method of frequency measurement using a CRO.
8. To find out decay time of a given capacitor
9. Frequency response characteristics of Push-Pull Amplifier.
10. To study distortion in Push Pull Amplifier.
11. Measurement of self inductance using Owen's Bridge.
12. Charging /discharging characteristics of capacitor.
13. To study Wien Bridge oscillator.
14. To study Hartley oscillator.
15. To study Anderson oscillator.
16. To calculate resonant frequency in LCR circuit.

Focus: This course focuses on Skill development aligned with all CO's

CO1	Apply the various procedures and techniques for the experiments
CO2	Use the different measuring devices and meters to record the data with precision
CO3	Apply the mathematical concepts/equations to obtain quantitative results
CO4	Develop basic communication skills through working in groups in performing the laboratory experiments by interpreting the results

List of Experiments B.Sc. IInd Year (IIIrd Sem.)

Electronics ,Code-BPHS0808

1. Measurement of self inductance using Owen's Bridge.
2. Charging /discharging characteristics of capacitor.
3. To study Wien Bridge oscillator.
4. To study Hartley oscillator.
5. To study Anderson oscillator.
6. To calculate resonant frequency in LCR circuit.
7. To study and plot VI characteristic of Zener diode.
8. To study RC, LC passive filter. (ETB-77)
9. To study RC phase shift oscillator of phase advanced type.
10. To study method of frequency measurement using a CRO.

Focus: This course focuses on Skill development aligned with all CO's

CO1	Apply the various procedures and techniques for the experiments
CO2	Use the different measuring devices and meters to record the data with precision
CO3	Apply the mathematical concepts/equations to obtain quantitative results
CO4	Develop basic communication skills through working in groups in performing the laboratory experiments by interpreting the results

Solid State Lab (BPHS0809)

List of Experiments

1. Energy band gap of a given semiconductor material by p-n junction diode.

2. Energy band gap of a given semiconductor material by four probe method.

3. Characteristics of NPN/ PNP junction transistor in common base and common emitter arrangement.

4. Voltage regulation by Zener diode & transistor.

5. Plank constant apparatus using LED

6. Dielectric constant Apparatus

7. Hysteresis loss of a transformer by CRO.

8. Different types of logic gates.

Focus: This course focuses on Skill development aligned with all CO's

Course Outcome: Students would able to

CO1	Apply the various procedures and techniques for the solid state devices
CO2	Have sound knowledge od transistors and regulated power supply
CO3	Apply the mathematical concepts/equations to obtain quantitative results
CO4	Construct electronics devices

Optics Lab Code: BPHS0810

List of Experiments

1. Wavelength of monochromatic light by Newton's rings.

2. Wavelength of monochromatic light with the help of Fresnel's biprism.

3. Refraction index of the material of the prism for the given colours (wavelengths) of mercury light with the help of a spectrometer.

4. Wavelength of spectral lines using plane transmission/ diffraction grating.

5. Wavelength of laser light by diffraction grating.

6. Focal length of combination of two lenses separated by distance d and verify the formula 1/F= (1/f1) + (1/f2) –d/f1f2

7. Polarization of light by simple reflection.

8. Fibre optic trainer for numerical aperture

Focus: This course focuses on Skill development aligned with all CO's

Course outcome: Students would able to

CO1	Gain sound knowledge of Physical Optics
CO2	Understand the concepts of Diffraction
CO3	Understand the concepts of Polarization
CO4	Apply concepts of fiber optics for wave communication

BCSO0075: PROGRAMMING LAB

Objective: The objective is to provide a study of the C programming language.

Credits: 02 **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 Skill development aligned with all CO's

Course Outcome: On Completion of this course, students are able to:
CO1 Write, compile and debug programs in C language.
CO2 Use different data types in a computer program.
CO3 Design programs involving decision structures, loops and functions.

BCSO0006: INTRODUCTION TO PROGRAMMING

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.	9
II.	**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.	9
III.	**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.	8

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 Skill development aligned with all CO's

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

CO1 Familiar with the concepts related to structured programming constructs
CO2 Design an algorithmic solution for a given problem and as well C program for a given algorithm.
CO3 Demonstrate their knowledge of, and ability to apply, programming fundamentals in different programming languages.

BCSO0005: FUNDAMENTALS OF COMPUTER

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 Skill development aligned with all CO's

Course 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.

BCSO0074: FUNDAMENTALS OF COMPUTER LAB

Objective: To provide hands-on experience in Microsoft Office tools.

Credits: 02 **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	**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	24

	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.	

Focus: This course focuses on Skill development aligned with all CO's

Course 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)

BPHS0001 : ENGINEERING PHYSICS (COMMON FOR ALL BRANCHES)
W.E.F. ACADEMIC YEAR 2020-21

OBJECTIVE: The Syllabus is designed and styled especially to give B.Tech I year students a sound base in fundamental physics as well as to give their exposure to a wide range of its utility in engineering and technology.

L–T–P: 3–1-2

Credits: 04 **Semester I &II**

Module No.	Content	Teaching Hours (Approx.)
I	**1. Interference & Diffraction:** Principle of superposition, Coherent Sources, Interference due to division of wave front- Biprism experiment and division of amplitude- Newton's ring Experiment, Diffraction: Fresnel and Fraunhofer diffraction, diffraction due to N-slits. **2. Polarization:** Concept of polarization of light, Phenomenon of double refraction, Superposition of ordinary and extra ordinary rays: Plane, Circularly and elliptically polarized light, Optical activity, Specific rotation, Biquartz polarimeter. **3. Electromagnetics:** Gauss's law in electrostatics, Ampere's law, Faraday law, Maxwell's equations (Integral and Differential forms-qualitative), Equation of continuity, Inconsistency in Ampere's law: Displacement current, Propagation of E-M waves in free space, Poynting vector and Poynting theorem.	**22**
II	**1. Solid State Physics & Superconductivity:** Classification of solids, Fermi level and Fermi energy(Qualitative), temperature dependence of conductivity in semiconductors, Hall effect, Meissner effect; Type I and Type II superconductors, Temperature dependence of critical field, Applications of superconductors. **2. Relativistic Mechanics:** Inertial & non-inertial frames, Galilean Transformations, Michelson-Morley experiment; Einstein's postulates, Lorentz transformation equations; Length contraction, Time dilation, Addition of velocities, Variation of mass with velocity, Mass energy equivalence. **3. Wave Mechanics & X-Ray Diffraction :** Wave - particle duality, de-Broglie hypothesis, wave packet, Heisenberg's uncertainty principle and its applications;(Non-existence of electrons in nucleus and Bohr's first orbit radius), Wave function and its normalization, Schrödinger's wave equation: time dependent and time independent wave equations, Particle in one dimensional potential box, Bragg's law, Compton effect.	**23**

Text Books:

*Engineering Physics by S.K. Gupta/ S.L. Gupta Vol. I & II

Reference Books:

*Optics - Ajoy Ghatak (TMH)
*Fundamental of Physics - Resnick, Halliday & Walker (Wiley)
*Concept of Modern Physics - by Beiser (Tata Mc-Graw Hill)
*Materials Science and Engineering - by V. Raghavan (Prentice- Hall India)

OUTCOME:

After completing the course the B.Tech. I year students would be able to apply the subject knowledge in engineering science and technology.

- Teaching-learning methodology of the course is such that the elementary knowledge of a student raises gradually to its complex aspects during the completion of the course program.
- A student of average caliber can comprehend the theoretical aspects easily without strain.

BPHS0002: ENGINEERING PHYSICS (SLOW LEARNERS)
W.E.F. ACADEMIC YEAR 2020-21

OBJECTIVE: The Syllabus is designed and styled especially to give B.Tech I year students a sound base in fundamental physics as well as to give their exposure to a wide range of its utility in engineering and technology.

L–T–P: 3–1-2

Credits: 04 **Semester I &II**

Module No.	Content	Teaching Hours (Approx.)
I	**1. Interference, Diffraction & Polarization:** Principle of superposition, Coherent Sources, Interference due to division of wave front- Biprism experiment and division of amplitude- Newton's ring Experiment, Diffraction: Fresnel and Fraunhofer diffraction, diffraction due to Single-slit ,Qualitative description of N slits diffraction (no derivation), Concept of polarization of light, Phenomenon of double refraction, Superposition of ordinary and extra ordinary rays: Plane, Circularly and elliptically polarized light, Optical activity, Specific rotation. **2.. Solid State Physics:** Classification of solids, Temperature dependence & temperature independence of conductivity of intrinsic semiconductors, Hall effect, Superconductivity, Meissner Effect, Type I and Type II superconductors.	**24**
II	. **1.Relativistic Mechanics:** Inertial & non-inertial frames, Galilean Transformations, Einstein's postulates, Lorentz transformation equations; Length contraction, Time dilation, Addition of velocities, Variation of mass with velocity, Mass energy equivalence (Einstein's Mass relation). **2. Wave Mechanics:** Wave - particle duality, de-Broglie hypothesis, wave packet, Heisenberg's uncertainty principle and its applications;(Non-existence of electrons in nucleus and Bohr's first orbit radius), Wave function and its normalization, Schrödinger's wave equation: time dependent and time independent, Particle in one dimensional potential box.	**22**

Text Books:
*Engineering Physics by S.K. Gupta/ S.L. Gupta Vol. I & II
***Engineering Physics by B.K.Singh and R.K.Dubey**
Reference Books:
*Concept of Modern Physics - by Beiser (Tata Mc-Graw Hill)
*Materials Science and Engineering - by V. Raghavan (Prentice- Hall India)

OUTCOME:
After completing the course, the B.Tech. I year students would be able to apply the subject knowledge in engineering science and technology.

- Teaching-learning methodology of the course is such that the elementary knowledge of a student raises gradually to its complex aspects during the completion of the course program.
- A student of average caliber can comprehend the theoretical aspects easily without strain.

BPHS0003: MODERN ENGINEERING PHYSICS (ADVANCE LEARNERS)
W.E.F. ACADEMIC YEAR 2020-21

OBJECTIVE: The Syllabus is designed and styled especially to give B.Tech I year students a sound base in fundamental physics as well as to give their exposure to a wide range of its utility in engineering and technology.

L–T–P: 3–1-2

Credits: 04 **Semester I &II**

Module No.	Content	Teaching Hours (Approx.)
I	**1.Wave Optics:** .Coherent sources, Fresnel's biprism, Interference in uniform and wedge shaped thin film, Necessity of extended sources, Newton's rings and its applications. Fraunhofer diffraction due to single slit and Qualitative description of N slits diffraction (no derivation), Spectra with grating.), Concept of polarization of light, Phenomenon of double refraction , Optical activity and Specific rotation. **2..Electromagentics:** Displacement current, Continuity equation, Maxwell's equations, Propagation of E M waves in vacuum and in conducting medium, Skin depth, Poynting vector and Poynting theorem, Plane electromagnetic wave in vacuum and their transverse nature.	**23**
II	. **1.Special Theory of relativity:** Inertial & non-inertial frames, Galilean Transformations, Einstein's postulates, Lorentz transformation equations; Length contraction, Time dilation, Addition of velocities, Variation of mass with velocity, Mass energy equivalence (Einstein's Mass relation).Relativistic relation between energy and momentum, Massless particles. **2.Introduction to Quantum Mechanics:** Black body radiation, Stefan's Law, Wien's law, Rayleigh-Jeans law and Planck's radiation law. Wave - particle duality, de-Broglie hypothesis, wave packet, Heisenberg's uncertainty principle and its applications;(Non-existence of electrons in nucleus and Bohr's first orbit radius), Wave function and its normalization, Schrödinger's wave equation: time dependent and time independent, Particle in one dimensional , Expectation values of dynamical variables.	**25**

Text Books:
*Engineering Physics by S.K. Gupta/ S.L. Gupta Vol. I & II
***Engineering Physics by B.K.Singh and R.K.Dubey**
Reference Books:
*Concept of Modern Physics - by Beiser (Tata Mc-Graw Hill)
*Materials Science and Engineering - by V. Raghavan (Prentice- Hall India)
* QUANTUM MECHANICS BY SATYA PRAKACH.

OUTCOME:
After completing the course, the B.Tech. I year students would be able to apply the subject knowledge in engineering science and technology.

- Teaching-learning methodology of the course is such that the elementary knowledge of a student raises gradually to its complex aspects during the completion of the course program.
- A student of average caliber can comprehend the theoretical aspects easily without strain.

GLA University, Mathura (U.P.)

Institute of Applied Sciences and Humanities

Department of Physics

Programme: M.Sc. Physics

COURSE STRUCTURE

M.SC. PHYSICS

Under

Choice Based Credit System (CBCS)

MPHS0001: MATHEMATICAL PHYSICS

OBJECTIVE: This course is used as mathematical tool to explain the advanced topics in all the branches of physics in terms of various mathematical application.

Credits: 04 **SEMESTER : I** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Legendre's Differential equation:** The Power seriese quation: Solution–Legendre Functions of the first and second kind –Generating Function- Rodrigues'– Orthogonal Formula Properties – Recurrence Relations. Beta and Gamma function – Properties – Relations between them. **Bessel's Differential Equation:** Power series Solution equation–Bessel Functions of First and Second kind- Generating Function –Orthogonal Properties –Recurrence Relations.	24
II	**Hermite Differential Equation:** Power series Solution–Hermite polynomials – Generating Function-Orthogonality –Recurrence relations -Rodrigues formula, **Languerre function.** **Fourier Transform:** Infinite Fourier Sine and Cosine transforms–Properties of Fourier transforms-Derivative of Fourier transform –Fourier transform of a derivative Fourier Sine and Cosine transform of derivatives-Finite Fourier transforms – Applications of Fourier Transforms. **Laplace Transform:** Properties of Laplace transforms –Derivative of Laplace transform– Laplace transform of a derivative –Laplace transform of periodic functions	24

Reference Books/ Text Books / Cases:

1. Applied Mathematics for Engineers and Physicists –Lious A Pipes and Lawrance R. Rarvill.
2. Mathematical Physics –AK Ghatak, IC Goyal and SL Chua-Macmillan India Ltd.
3. Vector and Tensor Analysis –Scham Series. 4. Mathematical Physics –SatyaPrakash

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes	After the completion of this course, students will be able to:
CO1	Learn Legendre's Differential equation.
CO2	Discuss power series solution equation and types of Bessel Functions.
CO3	Explain Hermite polynomials.
CO4	Understand Fourier transform and its properties.
CO5	Learn Laplace transform and its properties.

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

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

MPHS0002: CLASSICAL MECHANICS

OBJECTIVE: To learn how complex classical systems can be formulated and solved using the Hamiltonian and Lagrangian by observing symmetries of the system and/or through advanced co-ordinate transformations.

Credits: 04 **SEMESTER : I** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Lagrangian formalism:** Constraints, generalized coordinates. Principle Lagrange's equations from-Applications D'Alembert's of principle, Lagrangian (plane and spherical pendulums, L-C circuit), velocity dependent potential-Lagrangian for a charged particle in electromagnetic field, Euler Hamilton's-Lagrangian principle equation's from Hamilton's principle. **Hamiltonian formalism-I:** Principle of Least Action–Application sand Hamilton's of Hamiltonian equation of (motion of a particle in a central force field, projectile motion of a body).	24
II	**Hamiltonian formalism-II:** Cyclic coordinates and conservation theories, Canonical coordinates and canonical transforms, Conditions for a transformation to be canonical, generating functions, Lagrange and Poisson brackets. Hamilton equations in Poisson bracket from, Hamilton Jacobi theory. **Mechanics of continuous systems :** Analysis of the free vibrations of a linear triatomic molecule, Eigen value equation- Principal axis transformation-Frequencies and normal coordinates Lagrangian formulation for continuous systems, Hamiltonian formulation.	24

Reference Books/ Text Books / Cases:

1. Classical Mechanics : By Goldstein, Poole & Safko (Pearson 2002)
2. Classical Mechanics :By JC Upadhyaya (Himalaya Publishing House)
3. Classical Mechanics : H.M. Agrawal (New Age Publication 2017)
4. Classical Mechanics :Rana & Joag (TMH)
5. Classical Mechanics of Particles and Rigid Bodies :Kiran C Gupta. (New Age International Publishers)
6. Lagrangian and Hamiltonian Mechanics: Calkin (Allied Publishers 2000)
7. Lagrangian Dynamics : Dave Wells (schaum series 19)

Focus: This course focuses on Employability aligned with CO1

Course Outcomes	On completion of this course, students would be able to:
CO1	Apply Lagrangian and Hamiltonian operators to deal classically with various physical systems.
CO2	Understand symmetries of classical systems and employ the corresponding law of conservations.
CO3	Solve the problems using various canonical transformations, Poisson and Lagrange brackets.
CO4	Understand the general formalism of small oscillations and their propagation in continuous medium
CO5	Obtain eigenvalue equations, normal coordinates and normal modes for molecular systems.

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

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

MPHS0003: STATISTICAL MECHANICS

OBJECTIVE: Aim of this course is to develop an understanding of how the physics laws of statistical systems are formulated from scratch at the classical as well as quantum level with the aid of statistical distributions, and thereby partition function and entropy of the system.

Credits: 04 **SEMESTER : I** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Relation between thermodynamics and statistical mechanics:** Micro stages and macro states of a system – Phase space- Ensembles – Mean values and ensemble average – Density distribution in phase space- Liouville's theorem. Apriori probability postulate – Micro canonical, canonical and grand canonical ensembles –Quantization of phase space. Entropy and Probability –Equilibrium conditions: Thermal, mechanical and concentration equilibrium. Entropy of a perfect gas using micro canonical ensemble-Gibbs paradox. **Maxwell –Boltzmann statistics-I:**D istribution law- Maxwell velocity distribution-Equi-partition theorem. Canonical ensemble- Partition function-Ideal gas, Grand canonical ensemble Partition function-Ideal gas. Quantum Statistical Mechanics.	24
II	**Maxwell –Boltzmann statistics-II :** Postulates Indistinguishability-Bose-Einstein and Fermi-Dirac statistics and distribution laws. Partition function and thermodynamic quantities-Translational, rotational and vibrational partition functions - Specific heat of diatomic molecules. **Ideal Bose**: Einstein gas-Energy and pressure of the gas. Bose-Einstein condensation Liquid Helium-Two Fluid model-Phonons, protons, super fluidity. Ideal Fermi-Dirac gas Energy and pressure of the gas –Electronic specific heat, thermionic emission, white dwarfs	24

Reference Books/ Text Books / Cases:

1. Statistical Mechanics by SatyaPrakash and JP Agarwal (Pragati Prakahan-2002)
2. Statistical Mechanics by Gupta and Kumar (PragathiPrakahan -2002)
3. Statistical Mechanics by BK Agarwal and M Eisner (New Age Internaional)
4. Statistical Mechanics by RK Srivatava and J Ashok (Prentice Hall, India)
5. Introduction to phase transitions and critical Phenomena HE Stanley (Clrendon Press, Oxford).
6. Heat and Thermodynamics by Zemansky (TMH).

Focus: This course focuses on Employability aligned with CO1,CO3 and CO4.

Course Outcomes	After the completion of this course, students will be able to:
CO1	Differentiate between thermodynamics (Macro state) and statistical mechanics (Micro states).
CO2	Discuss different types of ensembles and equilibrium conditions.
CO3	Explain classical (Maxwell-Boltzmann) and quantum (Bose-Einstein and Fermi-Dirac) statistics.
CO4	Understand phenomenon of Bose Einstein condensation.
CO5	Familiar with two fluid models such as Phonons, Protons, super fluidity.
CO6	Interpret ideal Fermi Dirac gas.

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

COs	**POs/ PSOs**
CO1	PO1, PO3, PO4/ PSO1,PSO3
CO2	PO1,PO2, PO4/PSO1, PSO3
CO3	PO1, PO5/PSO1, PSO3, PSO4
CO4	PO1, PO3,PO4/PSO1, PSO3
CO5	PO1,PO3, PO4, PO5/PSO1, PSO4
CO6	PO1, PO3, PO5/PSO1, PSO3, PSO4

MPHS0004: QUANTUM MECHANICS- I

OBJECTIVE: This course is design in such a manner to explain the drawbacks in classical mechanics and modified the shortcomings in term of quantum physics.

Credits: 04 **SEMESTER : I** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Development of Old Quantum Theory:** Wilson- Somerfield Quantization rule, short commings of old quantum theory, dual nature of light and matter, phase and group velocity, equation of motion of matter waves,: Schrodinger's equation, physical interpretation to wave function, normalized and orthogonal wave function, expectation values of dynamical quantities, probability currect density ; particle flux, ehrensfest's theorem, mathematical proof of uncertainty principle, gaussiam wave packets, application of Schrodinger's equation; particle in a box, potential step, rectangular potential barrier (α - decay). Three dimensional harmonic oscillator.	24
II	**Spherically Symmetric System:** Three dimensional harmonic oscillator (Spherically Symmetric case), The Hydrogen atom, degeneracy, normal state of hydrogen atom, Operator and liner operator, eigen values and eigen function, the operator formalism in quantum mechanics, momentum operator, Hamiltonian operator, Hermitian operators and properties, the parity operators, commutation algebra, hygine berg uncertainty relation derived from operators, identical particles, symmetric and anti-symmetric wave function, pauli spin mates for electrons, commutation relation , density operator and density metrics	24

Reference Books/ Text Books / Cases:

1. Advanced Quantum Mechanics by Satya Prakash
2. A Text book Quantum Mechanics : PM Mathews and K Venkateshan (TMH)
3. Quantum Mechanics by Ghatak and Lokanathan (Macmillian)
4. Quantum Mechanics by E Merzbacher (John Wiley)

Focus: This course focuses on Employability aligned with CO2, CO5, CO6 and CO7.

Course Outcomes	After the completion of this course, students will be able to:
CO1	Understand inadequacy of classical mechanics and development of quantum mechanics to explain the dual nature of light.
CO2	Derive Schrodinger equations for matter waves and apply it to solve the various problems of quantum mechanics.
CO3	Explain physical significance of wave function to solve problems on expectation values of various dynamical quantities.
CO4	Learn 3D harmonic oscillator in spherically symmetric system
CO5	Familiar with operators system for various physical quantities such as momentum, Hermitian and Hamiltonian operator.
CO6	Derive the Heisenberg uncertainty relation from operator algebra.
CO7	Understand about symmetric and anti-symmetric wave functions.

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

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

MPHS0005: ELECTRONICS-I

OBJECTIVE: This course is designed for the learning of fabrication of electronic devices.

Credits: 04 **SEMESTER : II** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Regulated Power Supply:** Principle of Zener regulator, Transistorized Series regulator, Regulated power supplies using IC 723. Switch Mode Power Supply (SMPS). **Transistors**: BJT, JFET and MOSFET: working, configurations, characteristics, application as small signal amplifier. Hybrid parameters (h parameters), Hybrid π- model at small signal. High frequency model using hybrid πmodel. **Amplifiers**: Feedback in amplifiers and advantages of Negative feedback in amplifiers. Cascading in amplifiers. RC coupled amplifiers, Emitter follower, Differential amplifier and Darlington pair.	24
II	**Sinusoidal Oscillators**: Criterion of feedback oscillator and negative resistance oscillator, Phase shift Oscillator, Wein Bridge Oscillator, Crystal Oscillator. **Operational Amplifiers:** Characteristics of Ideal operational Amplifier, Block diagram of an IC operational Amplifier, Analysis of inverting and Non-inverting amplifier. Applications- Integrator, Differentiator, summing amplifier, Difference amplifier, Comparator, Logarithmic amplifier and exponential amplifier. **Waveform generator / Multivibrator :** Timer IC 555: Working and operating modes. Square wave, Rectangular wave, Triangular wave and Sine wave generation using IC555. Schmitt trigger.	24

Reference Books/ Text Books / Cases:

1. Integrated Electronics –Milman Halkies.
2. Microelectronics –Milliman & Grabel.
3. Digital principles and applications- Malvino and Leech
4. Operational amplifier –Gawkward
5. Fundamentals of electronics by JD Ryder, Wiely.
6. Electronic Devices and Circuit theory, R.L. Boylestad and L. Nashelsky, Prentice Hall

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes	After the completion of this course, students will be able to:
CO1	Discuss regulated power supply.
CO2	Familiar with different types of transistors and their operations.
CO3	Learn different types of amplifiers and oscillators.
CO4	Explain operational amplifiers and its applications.
CO5	Discuss various waveform generators and multi vibrators.

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

COs	**POs/ PSOs**
CO1	PO1,PO2, PO4/PSO1, PSO2,PSO3
CO2	PO1, PO3,PO4/PSO1, PSO3
CO3	PO1,PO2, PO4, PO5/PSO1, PSO4
CO4	PO1, PO3, PO5/PSO1, PSO3, PSO4
CO5	PO1, PO2, PO4/PSO1, PSO3, PSO4

MPHS0006 : QUANTUM MECHANICS- II

OBJECTIVE: This course is designed in such a way that students will have knowledge and ability to apply Quantum mechanics and Quantum Field Theory to high energy particles and fields.

Credits: 04 **SEMESTER : II** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Angular Momenta and their properties:** Angular Momenta operator in position representation, total Angular Momentum operators, Communication Rules, Eigen values of J^2 and J^z.. Eigen functions of J^y J^z Addition of Angular Momenta,: Clebsch – gordan coefficient **Time Dependent Perturbation Theory:** Time Independent Theory, Stationery perturbation theory (non-degenerate case), physical application of non-degenerate perturbation theory: normal helium atom, perturbed harmonic oscillator, zeeman effect, stationery perturbation theory : degenerate case, stark effect, variation method, ground state of hydrogen atom, The WKB Method.	24
II	**Relativistic Quantum Mechanics:** Klein –Gordon Equation, Plane wave solution and Equation of continuity, Probability density- Dirac Equation, alpha, beta- matrices, Plane wave solution, significance of negative energy states. Spin of Dirac particle Relativistic particle in central potential, Dirac Equation for central field force and its solution. **Quantization of Fields (II Quantization) :** The classical approach to field theory, relativistic lagrangian and Hamiltonian of a charged particle in electromagnetic field, quantum equation for the field , II quantization, quantization of non-relativistic Schrodinger equation, creation, annihilation and number operators , quantization of Klein –Gordon Equation.	24

Reference Books/ Text Books / Cases:

1. Advanced Quantum Mechanics by Satya Prakash
2. A Text book Quantum Mechanics : PM Mathews and K Venkateshan (TMH)
3. Quantum Mechanics by Ghatak and Lokanathan (Macmillian)
4. Quantum Mechanics by E Merzbacher (John Wiley)

Focus: This course focuses on Employability aligned with CO2 and CO7

Course Outcomes	After the completion of this course, students will be able to:
CO1	Explain the commutative and non-commutative properties of dynamical variables and their Eigen values and Eigen functions.
CO2	Discuss about the perturbation fields in case of non-degenerate systems and the fact of perturbation theory to modify Zeeman and Stark effects in both degenerate and non-degenerate systems
CO3	Apply Schrodinger's equation in relativistic dynamic systems and to know significance of negative energy states.
CO4	Apply a quantum mechanical approach to explain the field theory of continuum and discrete systems.

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

COs	**POs/ PSOs**
CO1	PO1,PO2, PO4/PSO1, PSO2,PSO3
CO2	PO1,PO3, PO4, PO5/PSO1, PSO4
CO3	PO1, PO2, PO4/PSO1, PSO3, PSO3
CO4	PO1, PO2, PO4/PSO1, PSO2, PSO4

MPHS0007: NUCLEAR PHYSICS

OBJECTIVE: To impart knowledge to make the students able to pursue research in experimental and theoretical nuclear physics.

Credits: 04 **SEMESTER : II** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Nuclear and Particle Physics:** Basic nuclear properties; size, shape and charge distribution, spin and parity. Binding energy, semi empirical mass formula, liquid drop model. Nature of nuclear force, form of nuclean-nuclean potential, charge-independence and charge-symmetry of nuclear forces, deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitation. Rotational spectra. **Nuclear Decay:** Fermi theory of beta-decay, Curie plots, Comparative half life, Allowed and forbidden transitions, Detection and properties of neutrino, Electromagnetic interactions in nuclei, Multipole transitions in nuclei, Parity and angular momentum selection rules, Internal conversion.	24
II	**Nuclear Reactions:** Discussion of Direct and Compound nuclear reaction mechanisms, expressions for scattering and reaction cross sections in terms of partial wave amplitudes, Resonances, Discussions and Applications of Breit-Wigner single level formula, compound nucleus theory. **Detectors and Accelerators:** Outline of interaction of charged particles and of Gamma-rays with matter. Detectors: Gas Filled counters (ionization Chamber), Scintillation counter, Spark Chambers, Cerenkov detectors. Accelerators: Ion Sources, Synchrotron, Introduction of Modern Colliders (LHC and RHIC), Storage Ring. **Particle Physics:** Basic interactions in nature, Elementary particles, Quantum numbers and conservation laws, Concept of isospin, Quarks and colors, Quark model, Eightfold way, Mesons and Baryons, Bound states and resonance states.	24

Reference Books/ Text Books / Cases:

1. Atomic and Nuclear Physics Vol. II: Ghoshal.
2. Nuclear Structure: Preston and Bhaduri.
3. Nuclear Physics (Problem oriented approach) : PHI(2016), Hari M.Agrawal
4. Introductory Nuclear Physics: Wong.
5. Nuclear Theory: Elton.
6. Nuclear Interactions: de Benedetti.

Focus: This course focuses on Employability aligned with CO1, CO2 and CO6

Course Outcomes	After the completion of this course, students will be able to:
CO1	Familiar with basics of nuclear physics such as size, shape and charge distribution, spin and parity.
CO2	Explain models for nuclear structure such as shell model.
CO3	Understand decay mechanism of nuclei and properties of neutrino.
CO4	Learn different types of nuclear reactions and Breit-Wigner single level formula
CO5	Understand working principle of different nuclear detectors.
CO6	Discuss interaction properties of elementary particles and quark model.

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

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

MPHS0008 : SOLID STATE PHYSICS

OBJECTIVE: This course covers the topics of the Solid State Physics to give a complete understating of Solid State Physics at the Post Graduate level to develop understanding of the crystalline structure, physical properties and underlying principles of the solid state.

Credits: 04 **SEMESTER : II** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Crystalline State & Structural Studies :** Crystal translational vectors, unit cell, Bravais lattices, Crystal system, Miller indices, Symmetry operations, Point groups, Space groups and their notation. Crystal structures of fcc, bcc, hcp, CsCl, NaCl, ZnS and Diamond. Bragg's law, Atomic structure factor, Geometrical structure factor and Debye Wallar factor, Concept of reciprocal lattice, Concept of Brillouin zones, Experimental methods of X-ray diffraction of crystals – Laue and Powder methods, Determination of unit cell parameters of a cubic crystal, Elements of neutron and electron diffraction. **Lattice Vibrations and Thermal Properties-I:** Elastic waves in one dimensional array of identical atoms, Vibrational modes of a diatomic linear lattice and dispersion relations, Acoustic and Optical modes, Infrared absorption in ionic crystals,	24
II	**Lattice Vibrations and Thermal Properties-II:** Phonons and verification of dispersion relation in crystal lattices. Lattice heat capacity- Einstein and Debye theories, Lattice thermal conductivity –Phonon mean free path, Origin of thermal expansion and Grunceisen relation. **Band Theory and Semiconductor Physics :** Failure of Free electron theory of metals, Bloch theorem, Behavior of electron in periodic potentials, Kronig- Penny model, E vs K relation, Density of states in a band, Effective mass of electron, Negative effective mass and concept of hole. Distinction between metals, Semiconductors and Insulators, Intrinsic semiconductors, Fermi level, Expressions for electron and hole concentrations in intrinsic and extrinsic semiconductors, Hall effect in semiconductors. Classification of imperfections, Schottky and Frenkel defects. DislocationsEdge and Screw dislocations, Dislocation multiplication, Grain boundaries.	24

Reference Books/ Text Books / Cases:

1. Crystallography and Solid State Physics – A.R. Verma and O.N. Srivastava
2. Solid State Physics – A.J. Deckker, Macmillian Indian Ltd, 2003.
3. Introduction to Solid State Physics – C. Kittel, Johan Wiley Sons Inc, New York
4. Solid State Physics- RL Singhal, KedarNath&Ramnath& Co, 2006
5. Elements of Solid State Physics – J.P. Srivastava, Prentice Hall India, 2006.
6. Elements of Solid State Physics -- Ali Omar, Pearson Education Inc, 2002.

Focus: This course focuses on Employability aligned with CO4 and CO6

Course Outcomes	After the completion of this course, students will be able to:
CO1	Understand different crystal structures and their symmetry by X ray diffraction method.
CO2	Formulate the expression of structure factor for BCC and FCC structure.
CO3	Discuss the propagation of elastic waves in Mono and Di atomic crystals.
CO4	Familiar with concept of Phonon and lattice heat capacity using Einstein and Debye' s theories.
CO5	Understand concept of thermal conductivity of solids
CO6	Discuss behavior of electron in periodic potential and concept of effective Mass.

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

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

MPHS0011: CLASSICAL ELECTRODYNAMICS

OBJECTIVE: This course would impart to students to gain an understanding of Maxwell's equations and the ability to apply them to explain the behaviour of electromagnetic wave propagation in different media, phenomenon of refraction, reflection, scattering, interference, diffraction and polarization.

Credits: 04 **SEMESTER : III** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Electro-Static Potentials and Maxwell's Equations:** Special techniques for calculating electrostatic potential : Green function, Electrical image and Poisson's and Laplace's equations methods, Solutions of Laplace's equation in Cartesian, spherical and cylindrical coordinates, Application of these methods to some potential problems, Multipole expansion of potential, scalar and magnetics vector potentials. Maxwell's equations, general wave equation, Gauge transformations-Lorentz and Coulomb gauges. **Interaction of Electromagnetic Waves with Matter :** Boundary conditions for the Electromagnetic field vector at interface of two media, Reflection and Refraction of plane Electromagnetic waves at Fresnel's relations, Reflection and Transmission coefficients, Brewester's angle, Total internal reflection, Dispersion in non-conductors, Basics concepts of waveguide, Propagahon of EM Waves between two plane conducting waves and in rectangular waveguide.	24
II	**Electromagnetic Fields due to moving charges:** Inhomogeneous wave equation band its solution for returned and lienard – wiechert potentials, Electromagnetic field due to uniformly and arbitrarily moving charges, Radiation produced by law velocity and arbitrarily accelerated charges, Bremsstraling synchrotron and cerentron radiation. **Radiation Fields:** Electric and Magnetic fields due to oscillating dipole and power radiated by it, Radiation due to small current element, fields due to half wave antenna and its power distribution, antenna array.	24

Reference Books/ Text Books / Cases:

1. Classical Electrodynamics by SP Puri, Tata McGraw-Hill Publishing Co., Ltd (2000).
2. Introduction to Electrodynamics by DJ Griffiths, Prentice- Hall of India (1998).
3. Electricity and Magnetism by MH Nayfeh and MK Brussel, John Wiley and Sons (1985).
4. Classical Electrodynamics by JD Jackson, John Wiley and Sons (1999).
5. Foundations of Electromagnetic Theory by JR Rietz, FJ Milford and Christy, Narosa Publishing house (1986)
6. Engineering Electromagnetic by WH Hayt and JA Buck Tata Mc-Graw Hill (2001)
7. Electromagnetic waves and Radiating systems by EC Jordan and KG Balmain, Prentic Hall (1968)

Focus: This course focuses on Employability aligned with CO1, CO3 and CO4.

Course Outcomes	After the completion of this course, students will be able to:
CO1	Learn different special techniques to calculate electrostatic potential and apply them to solve potential problems.
CO2	Familiar with scalar and magnetics vector potentials, Maxwell's equations, general wave equation and different types of gauges.
CO3	Interpret reflection and transmission of EM waves at the interface of two different media and their dispersion in non-conductors.
CO4	Understand propagation mechanism of EM waves between two conducting planes and in rectangular waveguide.
CO5	Derive expressions for the EM field produced by charges moving with constant / varying velocity.
CO6	Obtain expressions for EM fields and power radiated by oscillating dipole, small current element, half wave antenna and antenna array.

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

COs	**POs/ PSOs**
CO1	PO1,PO2, PO4/PSO1, PSO2,PSO3
CO2	PO1, PO4, PO5/PSO1, PSO3, PSO4
CO3	PO3, PO4, PO5/PSO1, PSO3, PSO4
CO4	PO1, PO2, PO4/PSO1, PSO3, PSO4
CO5	PO1, PO3, PO4,PO7/ PSO1, PSO3
CO6	PO1,PO2, PO4, PO8/PSO1, PSO3, PSO4

MPHS0012 : COMPUTATIONAL PHYSICS AND PROGRAMMING

OBJECTIVE: Objective of the course is to develop basic understanding and skills to FORTRON 77 language and its application in solving problems.

Credits: 04 **SEMESTER : III** **L – T – P**
3 1 0

Module No.	Content	Teaching Hours (Approx.)
I	Introduction to multiprogramming and time-sharing computers. Introduction to operating system. Login, creation of file and some important commands. Editor(s) and editing commands. Introduction to structured programming languages with reference to FORTRAN 77.	24
II	Constants and variables: Complex, double precision, logical and character. Arithmetic expressions, Arrays. Control statements : GO TO, Compute GO TO, IF, nested IF, Arithmetic IF, DO, Subscripted variables. Functions and Subroutines: Subprograms, Dimension Statement. Simple input/output statements. Elementary programming related to simple problems.	24

Reference Books/ Text Books / Cases:

1. Introduction to programming & Language in FORTRAN 77 , V. Rajaraman.
2. Computer Programming in FORTRAN 77,V.Rajaraman.

Focus : This course focuses on Employability and skill development aligned with all CO's

Course Outcomes	After the completion of this course, students will be able to:
CO1	Understand multiprogramming and time-sharing computers.
CO2	Familiar with operating systems, learn to login, creation of files and have knowledge of important commands.
CO3	Learn structured programming language with reference to Fortran 77 and apply it to complicated problems relating to physics.
CO4	Obtain knowledge of constants and variables: complex, double precision, logical and arithmetical expressions and arrays.
CO5	Understand and apply different control statements, subscripted variables, functions and subroutines.
CO6	Design elementary programming related to simple problems.

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

COs	POs/ PSOs
CO1	PO2,PO3, PO4/PSO1, PSO2,PSO3
CO2	PO1, PO3, PO5/PSO1, PSO3, PSO4
CO3	PO3, PO4, PO5/PSO1, PSO2, PSO4
CO4	PO1,PO2, PO7, PO8/PSO1, PSO3, PSO4
CO5	PO1, PO3, PO4,PO7/ PSO1, PSO3
CO6	PO1, PO5, PO7, PO8 /PSO1, PSO2, PSO4

MPHO0009: INTRODUCTION TO LINEAR AND DIGITAL INTEGRATED CIRCUITS-I (ELECTIVE-I)

OBJECTIVE: The objective of this course is to give knowledge of number systems and Boolean Algebra which will enable students to learn different type logical and sequential digital circuits.

Credits: 04 **SEMESTER : III** **L – T – P**

4 0 0

Module No.	Content **Digital Logic Circuits and Applications**	Teaching Hours (Approx.)
I	Cathode Ray Oscilloscope: Block Diagram of CRO. Applications of Oscilloscope: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency and Phase Difference. Number System and Logic Gates: Analog and Digital Circuits. Binary Numbers. Binary Number System, Decimal to Binary and Binary to Decimal Conversion. Octal and Hexadecimal Numbers. AND, OR, NOT, NAND and NOR Gates (realization using DL and TTL). XOR and XNOR Gates and their applications. Boolean Algebra: Boolean Laws and De Morgan's Theorems. Logic Simplification and Gate Minimization. Idea of Minterms and Maxterms. Conversion of Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. Binary Addition and Binary Subtraction using 2's Complement Method. Arithmetic Digital Circuits: Half Adders and Full Adders and Subtractors, 4-Bit Binary Adder-Subtractor. Data Selecting Circuits: Decoders, Encoders, Multiplexers, De-multiplexers.	24
II	Logic Sequential Circuits: Noise, Fan-out, Fan-in, Power and Speed. Flip Flops: Latch (NOR and NAND), R-S, D and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Master – Slave Flip Flop. Preset and Clear. Binary Counters: Asynchronous counters, Synchronous Counter, Decade Counter. Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers. Timers (IC 555): Block Diagram, Astable and Monostable Mode Applications. Phase Locked Loops (IC - 565): Block Diagram and Applications.	24

Reference Books/ Text Books / Cases:

1. Operational Amplifiers and Linear Integrated Circuits 6th edition, Robert F, Coughlin, Frederick F. Driscoll, Pearson Education, Asia India.
2. Design with Operational Amplifiers and Analog Integrated Circuits 2nd edition Sergio. Franco, McGraw-Hill NY USA

Focus: This course focuses on Employability and skill development aligned with all CO's

Course Outcomes	After the completion of this course, students will be able to:
CO1	Distinguish between analog and digital electronics.
CO2	Understand different type of number systems.
CO3	Learn simplification and evaluation of binary arithmetic problems on the basis of Boolean algebra and K-Map method.
CO4	Explain combinational and sequential digital logic circuits.

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

COs	**POs/ PSOs**
CO1	PO2,PO3, PO4/PSO1, PSO2,PSO3
CO2	PO3, PO4, PO5/PSO2, PSO3, PSO4
CO3	PO1,PO2, PO7, PO8/PSO1, PSO2, PSO4
CO4	PO1, PO5, PO7, PO8 /PSO1, PSO2, PSO3

MPHS0010: ELECTRONICS-II

OBJECTIVE: This course indents to develop concepts of analog and digital modulations in the field of communications. It will also focus on different measurement and instrumentation techniques.

Credits: 04 **SEMESTER : III** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Analog Modulation:** Concept of Amplitude modulation, envelop DSB, SSB modulation, Frequency and phase modulation, narrow and wide band FM, reactance modulator, reactance modulator stability—AFC, indirect method – Armstrong system, balanced slope FM detection, principles of phase discriminators. Fourier Transform. **Digital Modulation:** Sampling theorem, channel bandwidth for PAM signal, natural and flat top sampling, signal recovery through holding, quantization of the signal, quantization error, pulse code modulation, differential PCM, delta modulation, adaptive delta modulation.	24
II	**Filter:** Types of filter, characteristics of filters, filtering for noise reduction, shielding and grounding. **Opto electronics Devices**: LED, Photo diode, Photo transistor, Solar Cell, LASER Diode. **Measurement & Instrumentation:** Linear and non-linear curve fittings Chi-square test, Static and dynamic characteristic of transducers, measure displacement, temperature, pressure, mass, and fluid flow using transducers. signal conditioning and recovery, amplification, sensors and actuators. Lock in detector, box-car integrator	24

Reference Books/ Text Books / Cases:

1. Taub, H and Schilling, DL : Principles of Communication Systems (Tata McGraw Hill)
2. Young, P.H. : Electronics Communication Techniques
3. Tomasi, W. : Electronic Communication Systems
4. Kennedy, G. : Electronic Communication Systems

Focus: This course focuses on Employability and skill development aligned with all CO's

Course Outcomes	After the completion of this course, students will be able to:
CO1	Familiar with analog modulation and its different types for communication.
CO2	Learn digital modulation and its different types for communication.
CO3	Explain applications of Fourier Transform
CO4	Discuss types and characteristics of filters.
CO5	Understand Opto-electronic devices.
CO6	Explain characteristics and working of transducers.

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

COs	POs/ PSOs
CO1	PO2,PO3, PO4/PSO2, PSO3,PSO4
CO2	PO1, PO3, PO5, PO6/PSO1, PSO2, PSO4
CO3	PO3, PO4, PO5/PSO1, PSO2, PSO3
CO4	PO2,PO3, PO7, PO8/PSO1, PSO2, PSO4
CO5	PO1, PO3, PO4, PO6, PO7/ PSO2, PSO3
CO6	PO5, PO7, PO8 /PSO1, PSO2, PSO4

MPHS0013 : ATOMIC AND MOLECULAR PHYSICS

OBJECTIVE: To develop the fundamental theoretical knowledge in Atomic, Molecular Physics.

Credits: 04 **SEMESTER : IV** **L – T – P**
4 0 0

Module No.	Content	Teaching Hours (Approx.)
I	**Atomic Physics:** Dipole selection rules (examples with derivation), Natural and Doppler Broadening, Spin-orbit coupling, Lamb shift and Retherford experiment, Hyperfine structure of lines, Normal and specific mass shifts, Anomalous Zeeman effect, Paschen-Back and Stark Effects, Applications of Resonance Spectroscopy: ESR and NMR .	24
II	**Molecular Physics:** Rotational spectra of diatomic molecule as a rigid and non rigid rotator. Vibrational spectra of a diatomic molecule as a harmonic and anharmonic oscillator. A brief discussion of formation and derivation of molecular states . Vibrational structure of electronic transition: progression, sequence. Deslandre table. The Franck Condon principle .Dissociation energy. A brief discussion of Intensity alternation and missing lines in rotational spectra. Raman effect and vibrational and rotational Raman spectra of diatomic molecules.	24

Reference Books/ Text Books / Cases:

1. Physics of Atoms and Molecules: B.H. Bransden and C.J. Joachain.
2. Introduction to Atomic Spectra: H.E. White.
3. Introduction to Atomic Spectra: H.G. Kuhn.

Focus: This course focuses on Employability and skill development aligned with all CO's

Course Outcomes	On completion of the course, students would be able to:
CO1	Understand theoretical background of atomic spectra of mono and di atomic molecule.
CO2	Understand effects of electric and magnetic fields on spectral lines.
CO3	Explain the various types of spectra of di-atomic molecules as well as Infrared/ Raman spectra of molecules.
CO4	Understand Deslandre table, Franck Condon principle, intensity alternation and missing lines in rotational spectra.

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

COs	**POs/ PSOs**
CO1	PO2, PO4, PO5/PSO1, PSO2, PSO4
CO2	PO1,PO3, PO7, PO8/PSO1, PSO3, PSO4
CO3	PO2, PO3, PO4,PO6/ PSO1, PSO3
CO4	PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO4

MPHO0014: INTRODUCTION TO LINEAR AND DIGITAL INTEGRATED CIRCUITS-I (ELECTIVE-II)

OBJECTIVE: This course is designed for postgraduate students to give knowledge of Microprocessors (8 and 16 bits) and use of microprocessors in different digital applications.

Credits: 04 **SEMESTER : IV** **L – T – P**
4 0 0

Module No.	Content **Introduction to Microprocessors Architecture, Programming and Interfacing**	Teaching Hours (Approx.)
I	**Computer Organization:** Components, CPU or Microprocessor, Input Output Devices, Memory, Microprocessors. Computer Languages: Machine, Assembly and High Level Languages. **The 8085 Architecture and Microcomputer System:** The 8085 Architecture and its Operations, Block Diagram, PIN Diagram, ALU (Arithmetic Logical Unit), System Bus, Registers, Memory, Stack Memory, Control Unit, Logic Devices for Interfacing, Microprocessor System based Applications. **Introduction to 8085 Programming:** Basics of Assembly Language Programming, Instruction Format, Addressing Modes and Instructions: Data Transfer Operations, Arithmetic Operations, Logic Operations, Branch Operations, Programming Techniques like Looping and Counting.	24
II	**Concepts of Memory and Interrupts:** Types of Memory, Memory Mapping, Secondary and Cache Memory and 8085 Interrupts. **Timing and Control Circuitry:** Timing States, Control Operations, Instruction Cycle, Timing Diagram of Instructions: MOV and MVI. **Interfacing and Programmable Peripheral Devices:** In/Out Instructions, Control Word Register, Status Register, Basic Peripheral Devices, Transducers, A/D and D/A Converters, 8255 Programmable Peripheral Interface, Data Acquisition and Storage, Interfacing Keyboard and Seven Squeal Display.	24

Reference Books/ Text Books / Cases:

1. Microprocessor, Architecture, Programming and Application: R. S. Goonkar
2. Fundamental of Microprocessors and Microcontrollers: B. Ram
3. Introduction to Microprocessor: A. P. Mathur

4. Microprocessor and Interfacing: D. V. Hall

Focus: This course focuses on Employability and skill development aligned with all CO's

Course Outcomes	On completion of the course, students would be able to:
CO1	familiar with the architecture and the instruction set of an Intel microprocessor 8085.
CO2	Learn assembly language programming and its implications in various machine controlling activities.
CO3	Understand the interfacing of microprocessor 8085 with 8255 programmable peripheral interface.
CO4	Learn the interrupt commands and timing operations of 8085.
CO5	Use 8085 microprocessor in different digital applications.

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

COs	POs/ PSOs
CO1	PO2,PO3, PO4, PO6/PSO2, PSO4
CO2	PO1, PO3, PO5/PSO1, PSO3, PSO4
CO3	PO1, PO2, PO7, PO8/PSO2, PSO3, PSO4
CO4	PO2, PO3, PO4, PO6/ PSO1, PSO2, PSO3
CO5	PO5, PO7, PO8 /PSO1, PSO2, PSO4

MPHS0801 : GENERAL PHYSICS LAB – I

OBJECTIVES: Experiments are designed based on the theoretical concepts and principles of the subjects which are taught to them.

1. 'Y' of glass plate by Cornu's method.
2. To determination of Cauchy's constant by Spectrometer.
3. Hartmann's Formula using a prism and spectrometer.
4. To determine Plank's constant by vacuum type photo cell with three filters.
5. To measure "e/m" by bar magnet method.
6. To determine Di-electric constant of a specimen at a high frequency by Lecher wires.
7. To determine the Hysteresis loss of a transformer by CRO.
8. To study and verify the following:
   i. OR/NOR Function.
   ii. AND/NAND Function.
   iii. NOT/BUFFER Function.
9. To determine Transistor characteristics:

a. To study and plot the graph of the transistor input and output characteristics of Germanium transistor in CEC.
b. To study and plot the graph of the transistor input and output characteristics of Silicon transistor in CEC.

Focus: This course focuses on skill development aligned with all CO's

After completion of the course students would able to

CO1	Apply the various procedures and techniques for the experiments
CO2	Use the different measuring devices and meters to record the data with precision
CO3	Apply knowledge to design different electronic devices
CO4	Develop basic communication skills through working in groups in performing the laboratory experiments by interpreting the results
CO5	Perform complicated optics experiments

MPHS0802 : GENERAL PHYSICS LAB – II

1. Hartmann's Formula using a prism and spectrometer.
2. To determine Plank's constant by vacuum type photo cell with three filters.
3. To measure "e/m" by bar magnet method.
4. To determine Di-electric constant of a specimen at a high frequency by Lecher wires.

5. To determine Transistor characteristics:

a.To study and plot the graph of the transistor input and output characteristics of Germanium transistor in CBC.

b.To study and plot the graph of the transistor input and output characteristics of Silicon transistor in CBC.

6. To determine Transistor characteristics:

c. To study and plot the graph of the transistor input and output characteristics of Germanium transistor in CBC.
d. To study and plot the graph of the transistor input and output characteristics of Silicon transistor in CBC.

Focus: This course focuses on skill development aligned with all CO's

CO1	Apply the various procedures and techniques for the experiments
CO2	Design different transistors
CO3	Apply knowledge to design different electronic devices
CO4	Develop basic communication skills through working in groups in performing the laboratory experiments by interpreting the results
CO5	Perform complicated optics experiments

MPHS0803 : ELECTRONICS LAB – I

List of Experiments

1. Study of basic logic gates and to verify Boolean algebraic theorems.
2. Study of Op Amp as adder, integrator, differentiator and voltage follower.
3. Study and design of RS, D and JK Flip Flop using basic logic gates (on bread board).
4. Study of mod 4 counter and its application in frequency division.
5. Study and design of asynchronous and synchronous decade counters.
6. Study of SISO, SIPO, PISO, PIPO shift registers.
7. Study of binary to decimal encoder.
8. Study of PAM modulation and demodulation.
9. Study of Astable multivibrator on multivibrator training kit.
10. Monostable multivibrator using 555 timer IC.

Focus: This course focuses on skill development aligned with all CO's

Course Outcome:

1. Student will be able to demonstrate the significance and applications of digital electronics in day to day life.
2. Analysis of combinational and sequential digital logic circuits and ability to troubleshoot minor faults.
3. Students will be able to design basic digital and timing circuits.

MPHS0804 : ELECTRONICS LAB – II

List of Experiments

1. Write a program for 8085 Microprocessor for addition and subtraction of
    i. Two decimal numbers
    ii. Two hexadecimal numbers.
2. Write a program for 8085 Microprocessor to perform multiplication of two 8 bit numbers using bit addition method.
3. Write a program for 8085 Microprocessor to perform division of two 8 bit numbers using repeated subtraction method.
4. Write a program for 8085 Microprocessor to find the largest number from an array.
5. Write a program for 8085 Microprocessor to find the smallest number from an array.
6. Write a program for arranging an array of data in descending order.
7. Study of a seven segment display.
8. Study of analog to digital converter.
9. Study of pulse code modulation and demodulation.
10. Study of fibre optics transmitter and receiver for audio signal transmission.

Focus: This course focuses on skill development aligned with all CO's

Course Outcome:

- Student will be able to describe components of microprocessor 8085 and their role in working of processor.
- Student will be able to write an assembly language program code for 8 bit and 16 bit arithmetic operations.
- Student will learn the interrupt commands and timing operations of 8085.
- Microprocessor 8085 uses in different digital applications.

COURSE SYLLABUS

BPHO0006 : LASERS AND LASER APPLICATION

Credits: 04

L – T – P

3 1 0

Module No.	Content	Teaching Hours (Approx.)
I	**Laser & Laser Systems:** introduction to general lasers and their types. Review of elementary quantum electronics, concept of coherence, absorption, spontaneous emission and stimulated emission processes, relation between Eisnstein's A and B coefficients, principle of Laser, principle of Laser action, Characteristics of laser beam, Difference between ordinary light and laser radiation. Three & four level Lasers, Ruby laser, liquid and solid state Lasers and systems, Helium-Neon laser, (Gas Laser).	23
II	**Laser application:** Laser applications in medicine and surgery, materials processing, optical communication, metrology and holography industrial applications, Chemical application, Laser Spectroscopy including Raman's scattering, uses of Laser in Audio systems, LIDAR	22

Reference Books/ Text Books / Cases:

1. K. R. Nambiar, "Laser Principles, Types and Application" New Age International
2. S. A. Ahmad, "Laser concepts and Applications" New Age International
3. Ajoy Ghatak, "Laser and Application"

COURSE SYLLABUS

BPHO0007 : NANO SCIENCE AND NANO MATERIAL

Credits: 04

L – T – P

3 1 0

Module No.	Content	Teaching Hours (Approx.)
I	**Introduction:** Basic Principal of nano science and nano technology, synthesis of characterization of nanoparticles, clusters, buckey ball, structure of carbon nanotubes, Chemical vapour deposition (CVD) self assembly and process for industrial production, mechanical and thermal properties of nanotubes, thermo power in nanotubes, magnetic properties, polymer nano composite, nanotubes and nanosensors	23
II	**Quantum theory of nanoscience:** Time dependent & time independent Schrodingers wave equation for nanoparticles, particle in a box, potential step: reflection and tunneling (Quantum leaks) penetration of barrier, potential box (Trapped particle in 3D nanodot), electrotrapped in 2D plane (nanosheet), Quantum confined effect in nanomaterials. Quantum nanostructure: size and dimentionality effect, Fermi gas, potential wells, partial confinement, single electron tunneling, quantum wells, wires and quantum dots, quantum dot laser superconductor.	22

Reference Books/ Text Books / Cases:

1. C. P. Poole Jr., FJ owenes, introduction to nano technology
2. Introduction to solid state physics, 7th addition, C. Kittle
3. A. K. Bandhopadhyay “nano materials” new age international
4. Hand book of Nano structure materials nano technology Vol. -5 Acsademic press
5. Nano Technology- Richard backer (Wiley international publication)

COURSE SYLLABUS

BPHO0008 : SPACE PHYSICS

Credits: 04

L – T – P

3 1 0

Module No.	Content	Teaching Hours (Approx.)
I	**Introduction:** Nebular theory of formation of our Solar System, Solar wind and nuclear reaction as the source of energy, solar energy, application of solar energy in engineering and technology. **Sun and Planets:** Brief description about shape size, period of rotation about axis and period of revolution, distance of planents from sun, Bode's Law, Kepler's Law of planetary motion, Newton's law of motion from kepler,s law Newton's Law of gravitation, correction of Kepler's third law, determination of mass of earth, determination of mass of planets with respect earth. Brief description of Asteriods, Satellites and Comets.	22
II	**Stars and Classification of Stars:** Stellar spectra and structure, stellar evolution, nucleo-synthesis and formation of elements, Havard classification system, Hertzsprung-Russel diagram, Luminosity of star, variable stars, composite stars (white dwarfs, Neutron stars, black hole, star clusters, supermova and binary stars), Chandrasekhar limit. **Galaxies and creation of Universe:** Galaxies and their evolution and origin active galaxies and quasars. Early history of the university, Big – Bang and Hubble expansion model of the universe, cosmic microwave background radiation, dark matter and dark energy.	23

Reference Books/ Text Books / Cases:

1. K. S. Krishnaswami, "Astrophsics: A modern Perspective" New Age International
2. K. S. Krishnaswami, "Understanding cosmic Penorama" New Age International

Ph.D. Core-course Syllabus

(Department of Physics)

Institute of Applied Sciences and Humanities
GLA University, Mathura

SOLID EARTH GEOPHYSICS AND SEISMO-ELECTROMAGNETICS
(PPHS0001)

L T P

4 0 0

PART-I

Internal constitution of the earth, characteristics of lithosphere, and asthenosphere, causes of geodynamical processes, geodynamical models, continental drift. Ocean floor spreading, plate tectonics and its geological implications, new global tectonics and plate margin process, oceanic ridges of the triple junction, trenches and inland arcs, geodynamics of Indian subcontinents and formation of Himalayas, 90^0 e ridge.

PART-II

Origin of geomagnetic field, secular variations and westward drift, geomagnetic storms, Earth, s current, sun spot, solar flares, lunar and solar variations, palaeomagnetics studies of rock samples and their applications in geophysics, polar wandering, reversals of geomagnetic field.

PART-III

Focal depth epicenter of earthquakes great Indian earthquakes types and causes of earthquakes volcanic eruptions, seismic zones over Indian plate, earthquakes prediction techniques in India. Laboratory experiments, generation mechanism of seismo- electromagnetic emission and their propagation in crust, atmosphere, and magnetosphere, seismogenic effect in atmosphere, ionosphere and magnetosphere.

References:

1. Introduction to Geophysics, Howell Jr, Franklin, B., McGraw-Hill Series In The Geological Sciences
2. Physics of the earth,Frank D. Stacey, Paul M. Davis, Cambridge University Press
3. Plate tectonics and crustal evolution *(4th ed.), Condie, K.C. (1997), Butterworth-Heinemann.*
4. Earth's magnetism, Chapman,S. 2nd Ed, Methuen
5. Core and and geomagnetism, Jack A. Jacobs, Elsevier Science & Technology

Focus: This course focuses on Employability aligned with CO3 and CO6

Course Outcomes: On completion of this course, students would be able to:

CO1: Understand the internal constitution of earth
CO2: Explain geodynamical models, plate tectonics, plate margin, consequences of geophysical processes at plate margin
CO3: Understand the various geophysical models for origin of earth's magnetic field and its secular variations: westward drift and reversals of geomagnetic field and polar wandering, paleo- magnetism and its applications to geophysics
CO4: Explain sun spot, solar flares, lunar and solar variations, geomagnetic storms
CO5: Understand earthquakes, their types and causes, volcanic eruptions, seismic zones over Indian plate, earthquakes prediction techniques in India
CO6: Discuss laboratory experiments, generation and propagation mechanisms of seismo-electromagnetic emissions and their effect above earth surface

Instrumentation and signal processing
(PPHS0002)

L T P
4 0 0

PART-I

Amplifiers: Audio amplifiers, Power amplifiers, feedback amplifiers operational amplifiers, Filters: Low pass, High Pass, band pass, band reject, and notch filters, digital filters, A/D convertors, data acquisition

PART-II

Short electric dipole, field of the short electric dipole, thin linear antenna, Horizontal antenna above a plane ground, vertical antenna above a plane ground, borehole antenna, Yagi –Ude antenna, loop antenna

PART-III

Analog and digital signal recording; mechanism of signal recordings MATLAB; use of data acquisition tool box in data acquisition; Methods of data processing; Cepstral analysis, multifactor analysis, fractal analysis, weblet analysis, dynamic Fourier analysis, Principle components analysis.

References:

1. Antennas for all applications, John D. Kraus & Ronald J. Marhefka, Tata McGraw-Hill 3rd Edition.
2. Digital Signal Processing, Alanv.Pppenhien & Ronald W. Schafer, Preason Education, India
3. Digital Filters: Design and Applications, Antoniou Andreas, Tata McGraw-Hill
4. Electromagnetics with applications, John D., Daniel A. Fieisch WCB, Tata McGraw-Hill

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes: On completion of this course, students would be able to:

CO1: Understand the basic concepts of audio amplifiers, power amplifiers, feedback amplifiers operational amplifiers, and their various parameters
CO2: Describe the basic concepts of different type of filters and A/D convertors, and process of data acquisition
CO3: Obtain the expressions for electric field, magnetic field and power radiated by different type of antennas
CO4: Explain the different type of digital signals and method of their digitation, sampling frequency, dynamic range
CO5: Apply different type of signal analysis on digital data

Advanced Solid State Physics

(PPHS0003)

L T P

4 0 0

PART-1

Occurrence of non-ideal crystals, Bragg law & Diffraction method, Brillouin zones, Scattering factor, Mono-atomic and diatomic linear chain vibrations, phonon dispersion relation, Specific heat of solids, Debye model, Anharmonic interactions, thermal properties of solids, Electrical and thermal conductivity of metals, Lattice vacancies, Defects in solids, Shear strength of single crystals, Dislocation densities.

PART-1I

Band theory of solids, Quantization of orbitals in magnetic field, De Haasvan Alphen effect, Boltzmann transport equation, lattice conduction, phonon drag, phonon-phonon transition, Magnons, Electron-phonon and electron-electron interaction, BCS theory of superconductivity, Flux Quantisation,High temperature superconductor, Josephson tunneling, Heavy fermions, Electron behavior in non-crystalline solids.

PART-I1I

Quantization of Lattice vibrations, Plasmons and optical phonons, dispersion relation for magnons, Spin waves, Antiferromagnetic and ferromagnetic Sub-lattice magnetization and Specific heat, Fermion fields and Hartee-Fock approximation, Dynamics of electrons in magnetic field, Magneto resistance.

Reference Books:

1. Solid State Physics by C.Kittel.
2. Quantum theory of solids by C.Kittel.
3. Solid State theory by A.J.Decker.
4. Physics of phonons by G.P.Srivastava.
5. Solid State Physics by S.O.Pillai.
6. Crystallography by O.N. Srivastava & A.R.Verma

Focus: This course focuses on Employability aligned with all CO5 and CO6

Course Outcomes: On completion of this course, students would be able to:

CO1: Explain how diffraction of light waves on solid matter can be used to obtain lattice structure
CO2: Know about the atomic scattering factor, geometrical structural factor and Debye–wallar factor
C03: Know the concept of phonons, Brillouin zones and how the dispersion relationship appears for different lattice structures
CO4: Explain thermal and electrical properties of solids
CO5: Understand about the defects in solids and Classify solid state matter according to their band gaps
CO6: Know about superconductors and physics behind anti-ferromagnetism and ferromagnetism, dynamics of electrons in magnetic field
CO7: Understand about plasmons, optical phonons, magnons and their dispersion relation

Nanoscience & Technology

(PPHS0004)

L T P

4 0 0

PART-1

Basic principle of Nanoscience, Nanoparticles (nanos), Nanoclusters, Synthesis and characterization of Nanoparticles & Nanoclusters, Structure of C-60 Bucky- *ball*, Quantum well, Quantum wire and Quantum dots, Carbon Molecules.

PART-II

Structure of Carbon Nanotubes,Kinds of Carbon Nanotubes, Specific surface Area (SSA),Fullerenes, Different forms of solids from Carbon atoms, Synthesis of Carbon Nanotubes, Chemical vapor deposition (CVD), Self-Assembly, Continuous CCVD process for Industrial production, Mechanical and thermal properties, Elastic moduli,thermo power in Nanotubes.

PART-III

Band Structure of Nanotubes, density of states, Electronic transport in Nanotubes fibre, Model calculation for thermal and electrical conductivity, Band gap, magnetic properties, polymer nanocomposties, Nanoprobes and Sensors, Nano structures in electronics, Applications of Nanotechnology, principle of Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM).

Reference Books:

1. Science of Engineering Material and Carbon Nanotubes by C.M.Srivastava &C. Srinivasan.
2. Nanotechnology: Basic Science and emerging technology by Mick Wilaon.
3. Introduction to Nano scale science and technology by Ventra Massimilian, Evoy Heflin, James R. (Eds.) 2004, p-632.
4. Introduction to Nano electronics (Science, nanotechnology, Engineering and applications) by VLADIM IR V. Mitin, Dec. 2007.
5. Applied Nanotechnology by Jeremy Ramsden Elsvier, 978-0-8155-2023-8.
6. Nanotechnology in molecular diagnostic: K.K.Jain, Current techniques and Application, Horizon Scientific press, 2006.

Focus: This course focuses on Employability aligned with all CO1, CO3, CO5 and CO6

Course Outcomes: On completion of this course, students would be able to:

CO1: Understand the different physical, chemical and biological methods for synthesis of nanoparticles
CO2: Know about Quantum well, quantum wire and Quantum dots and their density of states
CO3: Know about carbon based nanostructures, their properties, structure, synthesis
CO4: Understand the influence of dimensionality of the object at nanoscale on mechanical, thermal, magnetic, electrical and optical properties
CO5: Understand the various characterization techniques (TEM, SEM) used at nanoscale
CO6: Knowledge of applications of nanomaterials in nano probes, sensors and electronic devices and multidisciplinary fields

Radiation Physics

(PPHS0005)

L T P

4 0 0

PART-I

Nuclear nomenclature. Binding energy and semi-empirical mass formula. Radioactive decay. Radioactivity general properties of alpha beta and gamma rays. Law of activity. Law of successive transformation. Natural radioactive series. Radioactive equilibrium. Alpha rays spectra and beta rays spectra. Theory of beta decay, gamma emission, electron captures and internal conversion. Nuclear isomerism. Artificial radioactivity. Nuclear cross section. Elementary ideas of fission and reactors fusion.

PART-II

Interaction of electromagnetic radiation with matter. Exponential attenuation. Thomson scattering. Photoelectric and Compton process and energy absorption. Pair production. Attenuation and mass energy absorption coefficients. Relative importance of various processes.

Interaction of charge particles with matter. Classical theory of inelastic collision with atomic electrons. Energy loss per ion pair by primary and secondary ionization. Dependence of collision energy losses on the physical and chemical state of the absorber. Cerenkov radiation. Electron absorption process. Scattering excitation and Ionization. Radiative collision. Bremsstrahlung Range energy relation. Back scattering.

PART-III

Scope of radiotherapy benign and malignant tumours. Tissue tolerance dose and tumour lethal dose. Dose Fractionation. Palliative and curative therapy. Spectral distribution of X-rays and effect of filtration. Output calibration procedures by backscatter and central axis depth doses. Isodose curves wedge filters. Shielding blocks and compensators. Treatment planning in teletherapy. Role of computers. Correction for body inhomogeneity contour shapes and beam obliquity. Rotation therapy and tissue air ratio. Tissue maximum ratio

Reference Books

1. Preston and Bhaduri: Structure of the Nucleus
2. Krane: *Introductory nuclear physics*
3. Glenn F. Knoll-Radiation Detection and Measurement
4. Arthur Beiser: Concepts of Modern Physics
5. F M Khan-Physics of Radiation Therapy

Focus: This course focuses on Employability aligned with all CO3, CO4 and CO5

Course Outcomes: On completion of this course, students would be able to:

CO1: Understanding the basic concepts in radiation physics
CO2: Understand the properties of ionizing radiation
CO3: Understand the methods of radiation detection
CO4: Understand the energy conversion and the generation of X-rays
CO5: Understand the role of the physicist in radiation medicine

Radiation Therapy

(PPHS0006)

L	T	P
4	0	0

PART-I

Telegamma therapy. Advantage over conventional X-ray therapy. Megavoltage X-rays therapy. Electron contamination. Particulate beam therapy. Relative merits of electron, neutron, X-ray and gamma ray beams. Neutron captures therapy. Modern trends. Heavy ion therapy.

PART-II

Quality assurance in radiation therapy. Necessity for accuracy in clinical dosimetry. Check of gantry and collimator movements and settings. Alignment of optical and radiation fields. Isocentric shift, interlocks, control panel displays. Cough movements. Shutter timer accuracy. Check of beam directing devices.

PART-III

Passage of heavy charged particles through matter. Energy loss by collision. Range energy relation. Bragg curve. Specific ionization. Stopping Power. Bethe Block formula.
Interaction of neutron with matter. Scattering Interactions. Neutron induced nuclear reactions. Action of radiation on living cells. Physical Factor influencing somatic effect. Dependence on dose rate, type and energy of radiation. Effect of radiation on skin and blood forming organs. Radiation Carcinogenesis.

Reference books

1. F M Khan-Physics of Radiation Therapy
2. Johns and Cunningham: Physics of Radiology
3. E J Hall: Radiobiology for Radiologist
4. IAEA Technical Report Series 398
5. IAEA Technical Report Series 430

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes: On completion of this course, students would be able to:

CO1: The knowledge of Radiation therapy (also called radiotherapy) uses radiation, such as high-energy x-rays (photons), gamma rays
CO2: Understand the Neutron captures therapy, Modern trends, Heavy ion therapy
CO3: Understand the effect of radiation on skin and blood forming organs
CO4: Understand the Radiation Carcinogenesis

Plasma Electrodynamics

(PPHS0007)

L	T	P
4	0	0

Part-I

Debye length, plasma oscillations, collisions; Plasma response to dc and ac electric fields; Plasma response to ac electric field in the presence of dc magnetic field; Electromagnetic wave propagation and reflection/ refraction from plasmas, metals and semiconductors; em wave propagation in magnetized plasma (Alfven wave, whistler wave, electron cyclotron wave etc.)

Part-II

Plasma production; Single particle motion in electric and magnetic fields, mirror machine; Surface plasma wave over plasma boundary

Part-III

Plasma wave, ion acoustic wave, two stream instability, laser driven fusion, applications in space

References :

1. Basic Plasma Physics, Basudev Ghosh, Narosa Publishing House (2014).
2. Introduction to plasma physics and control fusion, F. F. Chen, Springer (1984).
3. Interaction of electromagnetic waves with electron beams and plasmas, C.S. Liu and V K Tripathi, World scientific publishing Co. Pvt. Ltd., Singapore (1994),
4. Electromagnetic theory for telecommunications, CS Liu and V K Tripathi, Cambridge University Press, India. Pvt. Ltd. (2007).

Focus: This course focuses on Employability aligned with all CO4 and CO5

Course Outcomes: On completion of this course, students would be able to:

CO1: Learn about the fourth state of matter in rigorous manner
CO2: Understand plasma oscillations physics and its response in different kind of electric and magnetic fields
CO3: Discuss EM wave propagation through plasmas, magnetized plasmas, metals and semiconductors
CO4: Explain plasma production
CO5: Understand different application of plasmas

Non-linear Phenomenon in Plasmas

(PPHS0008)

L	T	P
4	0	0

Part-I

Heating of un-magnetized and magnetized plasmas by high power electromagnetic waves; Ponderomotive force, nonlinear plasma permittivity, self-focusing of laser beam in collisional and collision less plasmas.

Part-II

Laser excitation of plasma wave, acceleration of electron by plasma wave, laser beat wave heating, harmonic generation, parametric amplifier and parametric instabilities (SRS SBS).

Part-III

Laser interaction with carbon nanotubes and applications; Laser ablation of materials. High power radio wave modification of ionosphere, ELF generations.

References:

1. Introduction to plasma physics and control fusion, Springer, Francis F. Chen
2. Introduction of Electromagnetic waves with electron beams and plasma, World scientific publishing co. pvt. Ltd., Singapore, by CS Liu and V K Tripathi.
3. Electromagnetic theory for telecommunications, Cambridge University Press, India. Pvt. Ltd by CS Liu and V K Tripathi.
4. Self-focusing of laser beams TATA- McGraw-Hill Publishing Co. ltd., New Delhi, by M. S. Soda, A K Ghatak, and V K Tripathi.
5. Related review articles.

Focus: This course focuses on Employability aligned with all CO4 and CO5

Course Outcomes: On completion of this course, students would be able to:

CO1: Understand effect of heating on magnetized/unmagnetized plasmas by high power EM waves
CO2: Discuss self-focusing of laser beam in collisional and collision less plasmas
CO3: Explain phenomenon associated with plasma waves
CO4: Understand laser interaction with carbon nanotubes
CO5: Understand laser ablation of materials and high power radio waves modification of ionosphere

Advanced Cosmology

(PPHS0009)

L	T	P
4	0	0

Part I

Dynamics of expanding Universe and its matter/energy content; Robertson-Walker metric; Co-moving co-ordinates; Spatial geodesics; Number conservation; Energy & momentum conservation; Cold matter, hot matter and vacuum energy; The Thermal History of the Universe (Hot Big Bang model); Introduction to Inflationary Theory.

Part II

The Cosmological Principles; Friedmann-Robertson-Walker Model; Dynamics of Homogeneous and Isotropic Universe; Cosmological redshift and the Hubble law; Radiation dominated universe model; Matter dominated universe model; The gravitational lens effect; Redshift-luminosity relation; Cosmological Horizon.

Part III

The Bianchi type I universe model; The Kasner solutions; The energy-momentum conservation law in anisotropic universe; Models with perfect fluid; Inflation through bulk viscosity; Universe with dissipative fluid; The Lamaitre-Tolman-Bondi universe models

References Books:

1. Weinberg, S., Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity, 1972, John Wiley & Sons
2. Weinberg, S., Cosmology, Oxford University Press
3. Oyvind Gron & S. Hervik: Einstein's General Theory of Relativity: With Modern Application in Cosmology, Springer

Focus: This course focuses on Employability aligned with all CO4

Course Outcomes: On completion of this course, students would be able to:

CO1: Understand the dynamics of expanding universe and about Robertson-Walker metric
CO2: Explain different conservations like number conservation, energy momentum conservation in isotropic and anisotropic universe model
CO3: Discuss different cosmological models for example FRW model, homogeneous and isotropic universe model, radiation dominated and matter dominated models
CO4: Explain gravitational lens effect, red shift and cosmological horizon
CO5: Apply different Bianchi type universe models with perfect fluid with perfect fluid, inflation through bulk viscosity and universe with dissipative fluid

General Relativity

(PPHS0010)

L	T	P
4	0	0

Part I

Historical Perspective

Special Relativity: Theoretical and Observational formulation, Lorentz Transformations, Relativistic Mechanics, Classical field theory (symmetries and conservation laws).
Mathematical Formulation: Equivalence principle, Manifolds, Tensors, affine connection, Derivative operator, Riemann curvature, Geodesics, Killing Vectors, Parallel Transport.

Part II

Einstein Hilbert action, Einstein Field Equations, Lagrangian formulation of GR, Symmetries and conservation laws in General Relativity, Exact black hole Solutions (Schwarzschild black hole, Reisner Nordstrom black hole, FRW Model, Vaidya solution) and Black hole thermodynamics.
Applications of General Relativity of Solar System tests (bending of light, mercury perihelion advance, geodetic precession) Gravitational Waves

References:

1. L. D. Landau & E. M. Lifshitz: Classical Theory of Fields
2. S. Weinberg: General Relativity and Cosmology
3. B. F. Shutz: First Course in General Relativity
4. J. L. Synge: General Theory of Relativity
5. J. Hartle: General Relativity,
6. S. Caroll: Spacetime and Geometry

Focus: This course focuses on Employability aligned with all CO5

Course Outcomes: On completion of this course, students would be able to:

CO1: Explain the postulates of the special theory of relativity and General theory of relativity
CO2: Understand the behavior of curved space-time
CO3: Familiar with Einstein's field equation
CO4: Learn the concept of the solution of Einstein's field equation
CO5: Understand the black hole solution and thermodynamics
CO6: Study the Cosmological solutions

Advanced Nuclear Physics – I

(PPHS0011)

L	T	P
4	0	0

Part I

Parametrisation of nuclear masses (Weizsaecker formula), Properties of nuclear matter, Nuclear stability, Alpha, beta and gamma decays with selection rules, Particle emissions, Nuclear fission and fusion processes, Production of nuclear energy and working of a reactor.

Part II

Fermi gas model, Shell model, Collective rotational and vibrational models of nuclei, Microscopic description of nuclei using Hartree-Fock theory. Quarks and Leptons and their Interactions, Structure of Nucleo, Lepton and quark families, Different types of interactions, Neutrino interaction with matter.

Part III

Abundance of the elements in the solar system, Nucleo-synthesis, r-, s- and p-processes, Neutron resonant and non-resonant reactions, Hydrogen burning, Helium burning and production of carbon and oxygen.

References Books:

1. M. A. Preston and R. K. Bhaduri, (1982), Structure of the Nucleus, Addison-wesley,
2. M. K. Pal, (1982), Theory of Nuclear Structure, East-west Press.
3. W. E. Burcham and M. Jobes, (1998), Nuclear and Particle Physics, Addison-Wesley,
4. Rolfs and Rodney, Cauldrons in Cosmos: Nuclear Astrophysics, Chicago University Press

Focus: This course focuses on Employability aligned with all CO2 and CO4

Course Outcomes: On completion of this course, students would be able to:

CO1: Understand the nuclear properties
CO2: Understand the concept nuclear decay and working of a nuclear reactor
CO3: To impart knowledge on the various models and elementary particles physics
CO4: To impart knowledge on the neutrino interaction with matter
CO5: To impart knowledge on solar system and its principles

Advanced Nuclear Physics – II

(PPHS0012)

L	T	P
4	0	0

Part I

Particle Induced X-ray Emission (PIXE), Rutherford Back Scattering (RBS), Neutron Activation Analysis (NAA) and their applications, Gamma-ray Spectroscopy: Energy, Intensity, Angular correlation and Coincidence measurements.

Part II

Lifetime measurements using Doppler Shift Attenuation and Plunger techniques, Charged particles spectroscopy, Time of flight (ToF) technique, Positron Annihilation and Mossbauer Spectroscopy.

Part III

Production of beam of charged particles using Linear Accelerator and Tandetron Accelerator; Production of neutron using accelerator. Radiation detection using Si(Li), HPGe, Si-Surface Barrier and Scintillator detectors; Energy and timing signal processing using Pre-Amplifier, Amplifiers, CFD and TAC; Data Acquisition using MCA, FPGA based systems.

References Books:

1. S. N. Ghoshal (1998) Atomic and Nuclear Physics Vol. II, S Chand & Company Ltd.
2. H. Ejiri and M. J. A. de Voigt (1989), Gamma-ray and Electron Spectroscopy in Nuclear Physics, Oxford Studies in Nuclear Physics, Clarendon Press.
3. Glenn F. Knoll (1979), Radiation Detection and Measurements, John Wiley & Sons.
4. K. Siegbahn (1965) Alpha-, Beta- and Gamma-Ray Spectroscopy Vol. 2, North-Holland Publ. Company.
5. W. R. LEO (1987) Techniques for Nuclear and Particle Physics Experiments, Springer Verlag.

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes: On completion of this course, students would be able to:

CO1- Understand the principle of X-ray emission, and Rutherford back scattering
CO2- Understand the concept of Doppler shift attenuation and plunger techniques
CO3- To impart knowledge on positron annihilation and Mossbauer spectroscopy
CO4- To impart knowledge on linear Accelerator and tandetron accelerator
CO5- To impart knowledge on different detectors and data acquisition using systems

Syllabus

For UG courses

[DEPARTMENT OF CHEMISTRY]

BCHM 0101: Disaster management

Course Objectives:

1. To provide basic conceptual understanding of disasters and its relationships with development.
2. To gain understand approaches of Disaster Risk Reduction (DRR) and the relationship between vulnerability, disasters, disaster prevention and risk reduction.
3. To understand Medical and Psycho-Social Response to Disasters.
4. To prevent and control Public Health consequences of Disasters
5. To enhance awareness of Disaster Risk Management institutional processes in India
6. To build skills to respond to disasters.

Module - I:

(09 Lectures)

Concepts of Hazard, Vulnerability, Risks, Natural Disasters
Natural disaster:
Earthquake: Causes of Earthquakes - Distribution of earthquakes - Hazardous effects of - earthquakes - Earthquake Hazards in India - Human adjustment, perception & mitigation of earthquake.
Tsunami: Causes, Distribution, Hazardous effects, Human adjustment, perception & mitigation.
Volcanoes: Causes and distribution of Volcanoes, Hazardous effects of volcanic eruptions, Environmental impacts of volcanic eruptions/ Volcanic Hazards / Disasters
Cyclone: Causes, effects and mitigation
Floods :- Causes of floods - Flood hazards India - Flood control measures (Human adjustment, perception & mitigation)
Droughts: Causes, effects and mitigation

Module II:

(09 Lectures)

Man Made Disaster:
(i) Bomb threat, (ii) Explosion, (iii) Hazardous material spill/release, (iv) Campus shooting, (v) Terrorist incidence and (vi) Financial emergency such as {(a) A sudden health emergency, (b) unexpected loss of income, (c) Death in the family or other family emergency, (d) Rent in arrears and risk of eviction
Emerging approaches in Disaster Management - Three stages

1. Pre-disaster Stage (preparedness)
2. Emergency Stage
3. Post Disaster stage – Rehabilitation

INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources.

Module III:

(10 Lectures)

Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj/ Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders

DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm

DISASTER RISK MANAGEMENT IN INDIA

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment

Course Outcome

Students will be able:

1. *To understand and apply the Concepts of disaster management during and after the emergency situation.*
2. *To understand the relationship between development & disasters and follow up actions.*
3. *To know and implement preparedness plans for disaster response.*
4. *To set up, monitor, early warning systems and evaluation*
5. *To develop skills in surveillance system, outbreak investigation for emergency situations.*
6. *To learn and interpret the disaster management act in various organizations for risk reduction.*

Course Curriculum

B. Tech. I yr

(Enginering Chemistry)

Syllabus

[DEPARTMENT OF CHEMISTRY]

Credits: 04 **Semester I/II** **L–T–P: 3–1–0**

Objective: *The subject intends to provide understanding of the fundamental concepts of Chemistry applicable in Engineering Sciences with the emphasis on the latest technological advancements thereby preparing the students for a rewarding career in science and technology.*

Module No.	Content	Teaching Hours
I	**Chemical Bonding:** M.O. theory and its applications in homo & hetero diatomic molecules. Hydrogen bond, metallic bond and their applications. Semi-conductors. **Reaction intermediates** (carbocation, carbanion & free radical). Types of isomerism (optical and geometrical) chirality, elements of symmetry, diastereomers, optically active compounds, R-S configuration and E-Z geometrical isomers, conformation of ethane and *n*-butane. **Fuels**: Definition and classification of fuels. Analysis of coal and determination of calorific value by bomb calorimeter. **Synthetic petrol**: Bergius and Fischer Tropschs methods **Lubrication:** Introduction, classification, properties & uses of lubricants. **Ceramics:** Introduction, classification, scope & applications.	15
II	**Polymers:** Polymerization and its classification. Preparation, properties and uses of polymers: Thermoplastics (Polystyrene, Teflon and Nylon 66), Thermosetting polymer (Bakelite). Biodegradable polymers (PLA, poly β-hydroxy butyrate), molecular weights of polymers, natural rubber and its vulcanization, synthetic rubber (neoprene, Buna-S, Buna-N). **Water Treatment:** Introduction, hardness and its units, L-S Process, calgon process, zeolite and ion-exchange processes, reverse osmosis, treatment of municipal water, impurities in water, boiler feed water, boiler troubles and remedial measures **Functional materials:** Biomaterials, smart materials (piezoelectric, pyroelectrics & ferroelectrics) and advanced materials. **Glass:** Preparation, varieties & uses.	16
III	**Corrosion**: Introduction, consequences, types, theories of corrosion, (galvanic, pitting, stress, water line, intergranular & soil corrosion) and protection of corrosion. **Spectroscopy:** Elementary ideas and simple applications of UV, visible, infrared and NMR spectral techniques **Chemical Kinetics:** Order and molecularity of reactions, zero order, first and second order reactions. Integrated rate equations. Theories of reaction rates, factors affecting rate of reaction. pH, buffer solution (Henderson-Hasselbalch equation). **Introduction to Nanoscience & Nanotechnology:** Basic concepts of nanoscience and nanotechnology, fullerenes, graphenes, carbonnanotubes, principle and uses of SEM & TEM techniques. Applications of nanomaterials.	17

Text Book:

- Shashi Chawala **"***Theory and Practicals of Engineering Chemistry***"** 4th edition, Dhanpat Rai & Co pvt ltd.

Reference Books:

- Morrison & Boyd "*Organic Chemistry*",6th edition ,Pearson education
- I.L. Finar "*Organic Chemistry*",5th edition, Longmans Green & Co ltd.
- Y.R. Sharma "*Elementary Organic Spectroscopy: Principles and Chemical Applications***",** 1st edition, S. Chand and Co. ltd.
- S.S.Dara "*Text book of Engineering Chemistry and Pollution Control*" 2nd edition, S. Chand and Co.ltd.
- Marsh G Fontana "*Corrosion Engineering*" 3rd edition, Tata McGraw hill publishing Co ltd.
- Attkins & Others **"**Inorganic Chemistry" 5th edition, Oxford university press.
- Attkins & Other**s "***Physical Chemistry*" 6th edition, Oxford University press**.**

- Puri, Sharma and Pathania "*Principles of Physical Chemistry*" 44th edition, Vishal publishing Co. Jalandhar.
- K.J.Laidler "Chemical Kinetics" 3rd edition, Pearson education.
- Malik, Tuli and Madan "*Selected topics in Inorganic chemistry*", 7th edition, S. Chand and Co.ltd.
- T. Pradeep, "*A Textbook of Nanoscience & Nanotechnology*" Tata McGraw Hill, New Dehli, 2012.

Course Outcome:

After studying this course students will be able to

CO1. Gain knowledge of Chemical Sciences for better appreciation of applications in engineering field.

CO2. Develop thorough understanding of the fundamental concepts of Chemistry and its applications in the field of various Engineering Sciences such as Electrical, Mechanical, Environmental, Civil and Material Sciences and Technology.

CO3. Perform experiments, analyze and interpret the data of experiments will be enhanced.

CO4. Make the student aware with recent technological advancements and thus will be better equipped for a rewarding career in science and technology.

CO5. Understand spectroscopic techniques and their implementation for their academic purpose.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs	POs/PSOs
CO1	PO2
CO2	PO1
CO3	PO5
CO4	PO4
CO5	PO10

BCHS:0801 ENGINEERING CHEMISTRY LAB

Objective: *The subject intends to provide understanding of the fundamental concepts of Chemistry with practical exposure applicable in Engineering Sciences thereby preparing the students for a rewarding career in science and technology.*

Credits: 01 **Semester I/II** **L–T–P : 0–0–2**

Module No.	Content	Lab hours
I	• To prepare standard solution of sodium hydroxide N/10 by standardizing with the help of standard solution of oxalic acid. • To determine the strength of the given HCl solution using pH meter • Determination of temporary, permanent and total hardness of water sample by complexometric method using EDTA as complexing agent. • Determination of constituents and amount of alkalinity in a given water sample. • To determine the chloride ion in the given water sample by Argentometric method (Mohr's method). • Determination of Iodine value of given oil sample. • Determine of viscosity and surface tension of the given liquid. • Determination of rate constant for acid catalyzed hydrolysis of ethyl acetate through titration. • Determination of iron concentration in the sample of water by colorimetric method. The method involves the use of KCNS as color developing agent and the measurement are carried out at λ_{max} 480 nm. • To determine the ferrous ion content in the given iron ore by titrimetric analysis against standard $K_2Cr_2O_7$ solution using $K_3[Fe(CN)_6]$ as an external indicator. • To determine the percentage of available chlorine in the given water sample of Bleaching Powder by iodometric titration using starch as an internal indicator. • To determine the % of moisture in a given sample of coal by proximate analysis	**24**

Reference/Text books:

Shashi Chawala **"***Theory and Practicals of Engineering Chemistry***"** 4th edition, Dhanpat Rai & Co pvt ltd.

Course Outcome:

After studying this course students will be able to

CO1. Develop thorough understanding of the experiemnts of engineering chemistry and its applications

CO2. Perform experiments, analyze and interpret the data of experiments will be enhanced.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs	POs/PSOs
CO1	PO6
CO2	PO4

Syllabus

Environmental Studies

[DEPARTMENT OF CHEMISTRY]

BCHS 0201: ENVIRONMENTAL STUDIES

Credits: 02 **Semester III/IV** **L-T-P: 2-0-0**

Objective: *To create awareness towards various environmental issues like global warming, urbanization, pollutions, ozone layer depletion etc; their causes and remedial steps for protecting impacted society.*

Module No.	Content	Teaching Hours
I	**Basics of Environmental Studies**: Environmental Studies: Introduction, Scope and Importance Environment: Concept, Natural and Anthropogenic Environment Natural Environment: Structure & Function of Atmosphere, Hydrosphere, Lithosphere and Biosphere Ecology and Ecosystem: Definitions Types, Structure & Functions of Ecosystem. Natural Resources: Introduction, Classification, Concept of Conservation Present Status and related to Water Resources, Forest Resources and Mineral Resources.	9
II	**Current Environmental Problems:** Energy Resources: Introduction, Classification, Energy Use Patterns, Energy Crisis, Alternative Energy Resources Present Status and Major Issues Related to Fossil Fuels, Hydroelectricity, Nuclear Energy, Solar Energy and Biomass Energy. Effects of Human Activities on Environment: Effect of Agriculture, Housing, Mining, Transportation and Industries Environment Pollution: Causes, Effects and Control of Air Pollution, Water Pollution, Land Pollution and Noise Pollution Introduction and Management of Solid Wastes and Hazardous Wastes Global Environmental Challenges: Global Warming, Ozone Layer Depletion, Acid Rain, Urbanization, Overpopulation and Biodiversity Depletion.	9
III	**Environmental Protection:** Environmental Protection: Role of Citizens, Role of Government, Initiatives by NGOs, Contribution of International Agencies and Conventions Approaches to Environmental Protection: Public Awareness, Environmental Education, Environmental Ethics, Environmental Laws and Environmental Economics Tools and Strategies: Environmental Impact Assessment, Ecological Footprints and Sustainable Development Efforts towards Environmental Protection in India	8

Text Book:

- Deswal & Deswal, "**Environment and Ecology"** Dhanpat Rai & Co.

Reference Books:

- Benny Joseph, "**Environmental Studies"** Tata McGraw-Hill Education.
- AK De "**Environmental Studies**" New Age International Publisher, New Delhi.
- Shashi K Singh and Anisha Singh, "**Environmental Science & Ecology**" A.B. Publication.
- Agarwal and Sangal, "**Environment & Ecology**" Krishna's Educational Publisher's Meerut

Course Outcomes

CO1. Students will be able to understand the environmental issues pertaining to day-to-day living; gain awareness for the need of environmental education vis-à-vis education for sustainable development.
CO2. Students will acquire knowledge in ecological perspective and value of environment, biotic components, ecosystem process: energy, food chain, water cycle etc.
CO3. Students will be able to understand water quality standards and parameters, assessment of water quality, air pollution, pollutants, acid rain, global climate change and green house gases.
CO4. Students will learn to understand variety of social issues associated with environmental deterioration involving human components such as population, ethics and urban settlements.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs	POs/PSOs
CO1	PO5
CO2	PO4
CO3	PO6
CO4	PO3
CO5	PO8

Course Curriculum

Bachelor of Computer Applications

BCA II yr

[DEPARTMENT OF CHEMISTRY]

BCHS 0202: ENVIRONMENTAL STUDIES

Credits: 02 **Semester III** **L–T–P: 2–0–0**

Objective: *To create awareness in every Graduating student about the importance of environment, the effect of technology on the environment, eco-balance and make them sensitive towards environmental concerns for their Professional Endeavors.*

Module No.	Content	Teaching Hours
I	**Introduction & Concept of Ecosystem** **Environment**: Definition, Scope, Importance, Natural Resources **Ecosystem:** Concept, Structure & Function, Producers, Consumers & Decomposers; Energy Flow in the Ecosystem, Ecological Succession, Food Chains, Food Webs & Ecological Pyramids.	8
II	**Types of Ecosystem & Environmental Pollution:** Introduction, Types, Characteristics, Features, Structure & Functions of - Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem & Aquatic Ecosystems- Ponds, Streams, Lakes, Rivers, Oceans, Estuaries. **Definition, Causes, Effects & Control Measures of -** Air Pollution, Water Pollution, Land/ Soil Pollution, Noise Pollution, Thermal Pollution. **Solid Waste Management**: Causes, Effects & Control Measures of Urban & Industrial Wastes.	10
III	**Human Population & the Environment:** Family Welfare Programme, Environment & Human Health, Human Rights.Role of Information Technology in Environment & Human Health From Unsustainable to Sustainable Development, Urban Problems Related to Energy. **Climate Change**: Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents & Holocaust; Water Conservation, Rain Water Harvesting, Watershed Management Environmental Protection Act, Air (Prevention & Control of Pollution) Act, Water (Prevention & Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.	10

Text Book:

* K.M. Gupta, (2009), "*Environmental Studies,* Umesh Publications, New Delhi, 2nd ed.

Reference Books:

- Devendra S. Bhargava (2005), "*Foundation of Environmental Studies",* Galgotia

Publicaions Pvt. New Delhi, 1st ed

- S. Deswal & A. Deswal (2010), "*Environmental Ecology",* Dhanpat Rai & co. New Delhi.
- M. Anji Reddy (2008), "*Textbook of Environmental Science & Technology",* BS Publications, Hyderabad.

Course Outcomes

CO1. Students will be able to understand the environmental issues pertaining to day-to-day living; gain awareness for the need of environmental education vis-à-vis education for sustainable development.
CO2. Students will acquire knowledge in ecological perspective and value of environment, biotic components, ecosystem process: energy, food chain, water cycle etc.
CO3. Students will be able to understand water quality standards and parameters, assessment of water quality, air pollution, pollutants, acid rain, global climate change and green house gases.
CO4. Students will learn to understand variety of social issues associated with environmental deterioration involving human components such as population, ethics and urban settlements.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs	POs/PSOs
CO1	PO5
CO2	PO4
CO3	PO6
CO4	PO3
CO5	PO8

COURSE STRUCTURE

B. SC.(H) CHEMISTRY

Under

Choice Based Credit System (CBCS)

Credits Distributions as per CBCS

Sr. No.	Category	Minimum Credits	Maximum Credits
1	Core Courses (C)	84	88
2	Generic Electives (GE)	24	24
3	Discipline Specific Electives (DSE)	24	32
4	Ability Enhancement Compulsory (AEC)	4	8
5	Skill Enhancement Courses (SEC)	4	8
6	Mandatory Non-Credit Courses (MNC) (4 Courses)	-	-
Total		**140**	**160**

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
1.	BCHC 0001	Physical Chemistry-I	3	1	0	4	4
2.	BCHC 1002	General Chemistry-I	3	1	0	4	4
3	BMAS 1504	Applied Mathematics for Chemists (GE)	3	1	0	4	4
	BSBE 0001	Remedial Biology (GE)	3	1	0		
4	BPHS 1005	Ancillary Physics Course-I (GE)	3	1	0	4	4
5	BCSO 0005	Fundamentals of Computer (SEC)	2	0	0	2	2
6	BELH 0007	English Language and Skills–I (AEC)	3	0	0	3	3
PRACTICALS							
8	BPHS 1805	Physics Lab – I	0	0	4	2	4
9	BCHC 1901	Chemistry Lab-I	0	0	4	2	4
10	BCSO 0074	Fundamentals of Computer Lab (SEC)	0	0	2	1	2
						26	**31**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BCHC 0003	Organic Chemistry-I	3	1	0	4	4
2.	BCHC 1004	General Chemistry-II	3	1	0	4	4
3.	BMAS 0505	Statistics and Numerical methods (GE)	3	1	0	4	4
	BSBC 0011	Microbiology (GE)	3	1	0		
4.	BPHS 1006	Ancillary Physics Course-II (GE)	3	1	0	4	4
5.	BELH 0008	English Language and Skills-II (GE)	3	0	0	3	3
6.	BCHS 0201	Environmental Studies (AEC)	2	0	0	2	2
7.	BCTH 0101	Soft Skills – I (SEC)	1	0	0	1	1
PRACTICALS							
1.	BPHS 1806	Physics Lab II	0	0	4	2	4
2.	BCHC 1902	Chemistry Lab-II	0	0	4	2	4
3.	BELH 0802	English Language Lab – II (GE5)	0	0	2	1	2
						27	**32**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BCHC0005	Physical Chemistry-II	3	1	0	4	4
2.	BCHC1006	Organic Chemistry-II	3	1	0	4	4
3.	BCHC1007	Inorganic Chemistry –I	3	1	0	4	4
4.	-	DSE-1	3	1	0	4	4
5	BCTH 0102	Soft Skills – II (SEC)	2	0	0	2	2
PRACTICALS							
6.	BCHC0903	Chemistry Lab-III	0	0	4	2	4
7.	BCHC0904	Chemistry Lab-IV	0	0	4	2	4
8.	BCHC0905	Chemistry Lab-V	0	0	4	2	4
						24	**30**

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BCHC0008	Physical Chemistry-III	3	1	0	4	4
2.	BCHC0009	Organic Chemistry-III	3	1	0	4	4
3.	BCHC1010	Inorganic Chemistry –II	3	1	0	4	4
4.	-	DSE-2	3	1	0	4	4
5.	BCTH 0103	Soft Skills – II (SEC)	2	0	0	2	2
PRACTICALS							
6	BCHC0906	Chemistry Lab-VI	0	0	4	2	4
7	BCHC0907	Chemistry Lab-VII	0	0	4	2	4
8	BCHC0908	Chemistry Lab-VIII	0	0	4	2	4
						24	**30**

Fifth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BCHC0011	Physical Chemistry-IV	3	1	0	4	4
2.	BCHC0013	Inorganic Chemistry –III	3	1	0	4	4
3.	BCHC1015	Organic Chemistry –V	3	1	0	4	4
4.	-	DSE-3	3	1	0	4	4
PRACTICALS							
6.	BCHC0909	Chemistry Lab-IX	0	0	4	2	4
7.	BCHC0910	Chemistry Lab-X	0	0	4	2	4
8.	BCHC0911	Chemistry Lab-XI	0	0	4	2	4
						22	**28**

Sixth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BCHC1014	Physical Chemistry-V	3	1	0	4	4
2.	BCHC0012	Organic Chemistry-IV	3	1	0	4	4
3.	-	DSE-4	3	1	0	4	4
4.	-	DSE-5	3	1	0	4	4
PRACTICALS							
5.	BCHC0912	Chemistry Lab-XII	0	0	4	2	4
6.	BCHE 0951	PROJECT (DSE-6)	0	0	8	4	8
						22	**28**

I. CORE COURSES

S. NO.	CODE	SUBJECT	TEACHING SCHEME L-T-P	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
1.	BCHC 0001	Physical Chemistry - I	3-1-0	4	4	
2.	BCHC 2002	General Chemistry – I	3-1-0	4	4	
3.	BCHC 1003	Organic Chemistry - I	3-1-0	4	4	
4.	BCHC 2004	General Chemistry - II	3-1-0	4	4	
5.	BCHC 0005	Physical Chemistry – II	3-1-0	4	4	
6.	BCHC 1006	Organic Chemistry - II	3-1-0	4	4	
7.	BCHC 0007	Inorganic Chemistry - I	3-1-0	4	4	
8.	BCHC 0008	Physical Chemistry – III	3-1-0	4	4	
9.	BCHC 0009	Organic Chemistry - III	3-1-0	4	4	
10.	BCHC 1010	Inorganic Chemistry - II	3-1-0	4	4	
11.	BCHC 0011	Physical Chemistry – IV	3-1-0	4	4	
12.	BCHC 0012	Organic Chemistry - IV	3-1-0	4	4	
13.	BCHC 0013	Inorganic Chemistry - III	3-1-0	4	4	
14.	BCHC 1014	Physical Spectroscopy	3-1-0	4	4	
15.	BCHC 1015	Organic Chemistry – V	3-1-0	4	4	
PRACTICALS						
1.	BCHC 1901	Chemistry Lab 1	0-0-4	2	4	
2.	BCHC 2902	Chemistry Lab 2	0-0-4	2	4	
3.	BCHC 0903	Chemistry Lab 3	0-0-4	2	4	
4.	BCHC 0904	Chemistry Lab 4	0-0-4	2	4	
5.	BCHC 0905	Chemistry Lab 5	0-0-4	2	4	
6.	BCHC 0906	Chemistry Lab 6	0-0-4	2	4	
7.	BCHC 0907	Chemistry Lab 7	0-0-4	2	4	
8.	BCHC 0908	Chemistry Lab 8	0-0-4	2	4	
9.	BCHC 0909	Chemistry Lab 9	0-0-4	2	4	
10.	BCHC 0910	Chemistry Lab 10	0-0-4	2	4	
11.	BCHC 0911	Chemistry Lab 11	0-0-4	2	4	
12.	BCHC 0912	Chemistry Lab 12	0-0-4	2	4	
			TOTAL	84		

II. ELECTIVE COURSES

IIA. Discipline Specific Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L-T-P-J	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
1.	BCHE 1001	Fundamentals of Chemical Analysis	3-1-0-0	4	4	
2.	BCHE 1002	Organic Spectroscopic techniques	3-1-0-0	4	4	
3.	BCHE 1003	Chromatographic Techniques	3-1-0-0	4	4	
4.	BCHE 1004	Electroanalytical and Radioanalytical techniques	3-1-0-0	4	4	
5.	BCHE 0005	Fuel Cell Technology	3-1-0-0	4	4	
6.	BCHE 0006	Green Chemistry and Corrosion Science	3-1-0-0	4	4	
7.	BCHE 0009	Inorganic Spectroscopic techniques	3-1-0-0	4	4	
8.	BCHO 0101	Nanomaterials and Nanotechnology	3-1-0-0	4	4	
9.	BCHO 0102	Technology of Surface Coating	3-1-0-0	4	4	
10.	BCHO 0103	Material Science & Engineering	3-1-0-0	4	4	
11.	BCHO 0104	Introduction to Biophysical Chemistry	3-1-0-0	4	4	
12.	BCHE 0008	Industrial Chemicals & Environment	3-1-0-0	4	4	
13.	BCHE 0951	Project**	0-0-0-8	4	8	
Minimum 24 Credit are required including **						

II B. Generic elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME L-T-P	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
1.	BMAS 1504	Applied Mathematics for Chemists	3-1-0	4	4	
2.	BMAS 0505	Statistics and Numerical Methods	3-1-0	4	4	
3.	BPHS 1005	Ancillary Physics Course-I	3-1-0	4	4	
4.	BPHS 1006	Ancillary Physics Course-II	3-1-0	4	4	
5.	BSBC 0011	Microbiology	4-0-0	4	4	
6.	BSBE 0001	Remedial Biology	3-1-0	4	4	
7.	BCSO0006	Introduction to Programming	3-0-0	3	3	
8.	BELH 0008	English Language Skills-II	3-0-0	3	3	
PRACTICALS						
1	BPHS 1805	Physics Lab – 1	0-0-4	2	4	
2	BPHS 1806	Physics Lab – 2	0-0-4	2	4	
3	BCSO 0075	Programming Lab	0-0-2	1	2	
4	BELH 0802	English Language Lab - II	0-0-2	1	2	
Minimum 24 Credit are required						

III ABILITY ENHANCEMENT COMPULSORY

S. NO.	CODE	SUBJECT	TEACHING SCHEME L-T-P	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
1.	BELH 0007	English Language Skills-I	3-0-0	3	3	
2.	BCHS 0201	Environmental Studies	2-0-0	2	2	
			Total	5	5	
Minimum 4 Credit are required						

IV SKILL ENHANCEMENT COURSES

S. NO.	CODE	SUBJECT	TEACHING SCHEME L-T-P	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
1.	BCSO 0005 BCSO 0074	Fundamentals of Computer Fundamentals of Computer Lab	2-0-0 0-0-2	2 1	2 2	
2.	BCTH 0101	Soft Skills - I	1-0-0	1	1	
3.	BCTH 0102	Soft Skills - II	1-0-0	1	1	
4.	BCTH 0103	Soft Skills - III	2-0-0	2	2	
5.	BCTH 0104	Soft Skills - IV	2-0-0	2	2	
			Total	9	10	
Minimum 4 credits are required						

S. NO.	CODE	SUBJECT	TEACHING SCHEME L-T-P	CREDITS	CONTACTS HR/WK	PRE- REQUISITES
1.	BCHS0101	Engineering Chemistry	3-1-0	4	4	
2.	BCHS0102	Chemical Science	3-1-0	4	4	
3.	BCHS 0103	Material Chemistry	3-1-0	4	4	
4.	BCHS0201	Environmental Studies	3-1-0	4	4	
5.	BCHS0202	Environmental Science	3-1-0	4	4	
6.	BCHM0201	Disaster Management	3-1-0	4	4	
7.	BCHO0101	Nanomaterials and Nanotechnology	3-1-0	4	4	
8.	BCHO0102	Technology of Surface Coating	3-1-0	4	4	
9.	BCHO0103	Material Science & Engineering	3-1-0	4	4	
10.	BCHO0104	Introduction to Biophysical Chemistry	3-1-0	4	4	
			Total	40	40	

COURSES OFFERED TO OTHER DEPARTMENTS

DETAILED SYLLABUS

SEMESTER - I

BCHC 0001: PHYSICAL CHEMISTRY - I

Objective: *This course aims to expose the students to the various concepts and applications of Chemical Kinetics, Ionic Equilibrium, and solutions.*

Credits: 04 **Semester I** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Chemical Kinetics:** Chemical kinetics and its scope, rate of reaction, order and molecularity of reactions, pseudo-molecular reactions. Derivation of rate equation of zero, first, second and fractional order reactions and their characteristics. Determination of order of reaction by rate determining step reactions method, integration method, graphical method, differential method, equi-fractional method and Ostwald isolation method. Collision theory for bimolecular reactions, transient state theory. Factors affecting rate of reaction-concentration, pressure, light, catalyst and temperature (temperature coefficient), quantitative effect of temperature on rate of reaction by Arrhenius equation. Concept of activation energy. Lindeman's theory of unimolecular reactions. **Ionic equilibria–I:** Strong and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant, ionic product of water. Ostwald dilution law and its limitations. pH value. Buffer solution; derivation of Henderson equation; buffer capacity, buffer action and application of buffer solution in analytical chemistry and biological processes in human body.	24
II	**Ionic equilibria–II:** Salt hydrolysis – calculations of hydrolysis constant, degree of hydrolysis and pH of different types of salts. Common ion effect, solubility and solubility product of sparingly soluble salts and its applications. **Solution**: Dilute solution, semi-permeable membrane and its preparation, osmotic pressure and it's measurement by Berkley & Hartley method. Colligative properties-Lowering of vapour pressure, Raoult's law for solution of nonvolatile solute and its derivation. Ostwald & Walker dynamic method for determination of molecular weight of nonvolatile solute. Raoult's law for missicible liquids, Ideal and non–ideal solutions. Henry's law. Elevation in boiling point, Derivation of expression in between elevation in boiling point and molecular weight of nonvolatile solute. Landsberger method & Cottrell's method for determination of molecular weight of nonvolatile solute. Depression in freezing point, derivation of expression in between depression in freezing point and molecular weight of nonvolatile solute. Beckmann's method for depression in freezing point and Rast camphor method for determination of molecular weight of non-volatile solute. Vant Hoff's factor. Abnormal osmotic pressure and molecular weight.	24

Text Book:

(1) Hofmann, A. Physical Chemistry Essentials, 1st ed.; Springer International Publishing: Basel, Switzerland, 2018.
(2) Lones, L. Essentials of Physical Chemistry; Createspace Independent Publishing Platform: North Charleston, SC, 2017.
(3) Shillady, D. Essentials of Physical Chemistry; CRC Press: Boca Raton, FL, 2011.
(4) Essentials of Physical Chemistry; Miller, F., Ed.; NY Research Press, 2017.
(5) Bahl, B. S.; Tuli, G. D.; Bahl, A. Essentials of Physical Chemistry, 24th ed.; S Chand: New Delhi, India, 2000.

Reference Books:

(1) Woldeamanuel, M. M. Text Book of Physical Chemistry for Science and Engineering Students; LAP Lambert Academic Publishing, 2019.
(2) Waldeck, D. H.; Kuhn, H.; Forsterling, H.-D. Principles of Physical Chemistry; John Wiley & Sons: Nashville, TN, 2013.
(3) Raff, L. M. Principles of Physical Chemistry; Pearson: Upper Saddle River, NJ, 2001.
(4) Atkins, P. W.; Clugston, M. J. Principles of Physical Chemistry; Pitman Publishing: Harlow, England, 1982.

Focus: This course focuses on employability aligned with CO's.

Outcome:
After studying this course students will able to:

CO1: Determine the order of reaction, reaction rate, degree of ionization constant pH etc.
CO2: Desire the relation for rate constant, half-life.
CO3: Understand theories of reaction rate.
CO4: Derive the expression for colligative properties.
CO5: Calculate modular weight using difference colligative properties, degree of hydrolysis
CO6: Deduce Raoult'sLaw, Henry's law, Van't Hoff factor.
CO7: Develop competitive skills required for competitive examinations

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO8/PSO1

BCHC 1002: GENERAL CHEMISTYRY - I

Objective:*This course aims to expose the students to the various concepts and applications of general chemistry and general science.*

Credits: 04 **Semester I** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Atomic Theory – Structure of an Atom:** The concept of atoms and molecules; Earlier model (Rutherford model, Dalton's atomic theory, Bohr's Theory) **Acids, Base, and Salts,** **Mole concept**: Expressing concentration of solution (Molarity, Normality, Formality, Molality, mole fraction etc. **Chemical reactions:**Types & balancing of chemical equations involving common oxidation-reduction, neutralization and displacement reactions. **Atomic Structure** Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation (no derivation), significance of Ψ and Ψ^2, quantum numbers, shapes of s, p, d orbitals. Aufbau principle, Hund's multiplicity rule and Pauli exclusion principle. Electronic configurations of the elements and ions. **Periodic Properties:** Classification of elements on the basis of s, p, d, f subshells. Periodic properties- atomic and ionic radii, ionization energy, electron affinity and electro negativity-definition-trends in periodic table and factors affecting them.	24
II	**Valuation of Analytical Data**: Significant figures, determinant and non-determinant errors, absolute and relative errors, terms of mean and median, precision and accuracy in chemical analysis, determining accuracy of methods, standard deviation, numerical problems related to evaluation of analytical data. **Energetics**: -First law of thermodynamics, Internal energy, Enthalpy, Heat of reaction, heat of formation, heat of combustion, heat of neutralization, heat of fusion, heat of vaporization. Hess's law of heat summation. Second law of thermodynamics, Entropy, Free energy, Criterion of spontaneity. **Chemical Bonding–I:** Types of bonding: Ionic bond, Covalent Bond, Co-ordinate bond. Hydrogen bond. Directional characteristics of covalent bond. Lattice energy and solvation energy and solubility of ionic solids. Born-Haber cycle. Fajan's rule. Percentage ionic character from dipole moment and electronegativity difference. Metallic bond- free electron model, valence bond and band theories. Valence bond theory and its limitations. Molecular orbital theory and its limitations. VSEPR Theory: various types of hybridization and shapes of	24

	simple inorganic molecules and ions (BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7, H_2O, NH_3, XeF_2, XeF_4, BF_4^-, PF_6^-, $SnCl_6^{2-}$). **Colloidal State:** Definition and classification of colloids. Difference between lyophobic and lyophilic sols. Kinetic, optical and electrical properties of sols, stability of colloids, protective action of colloids-gold number, coagulation of colloid-Hardy-Schulze law. Liquids in liquids (emulsions): Types of emulsions, preparation and Emulsifiers. Liquids in solids, (gels) classification, preparation and properties. General applications of colloids. Colloidal electrolytes.	

Reference/ Text Books:

1. Ebbing, D. D.; Gammon, S. D. General Chemistry, 7th ed.; Houghton Mifflin (Trade): Boston, MA, 2001.
2. Barone, S. General Chemistry; Blackwell Science: Oxford, England, 2000.
3. Hill, J. W.; Petrucci, R. H. General Chemistry: An Integrated Approach, 6th ed.; Prentice Hall: Old Tappan, NJ, 1996.
4. McMurry, J. E.; Fay, R. C. General Chemistry: Atoms First: United States Edition; Pearson: Upper Saddle River, NJ, 2009.
5. Umland, J. B.; Bellama, J. M. General Chemistry, 3rd ed.; Brooks/Cole: Florence, KY, 1999.
6. Brady, J. E. General Chemistry: Principles and Structure, 4th ed.; John Wiley & Sons, 1986.
7. Malone, L. J. Basic Concepts of Chemistry, 7th ed.; John Wiley & Sons: Nashville, TN, 2004.
8. Dingle, C. F.; etc. Basic Chemistry, 3rd ed.; Hodder & Stoughton: London, England, 1971.

Focus: This course focuses on employability aligned with CO's.

Outcome:

After studying this course students will able to:

CO1: Prepare solutions in different case.
CO2: Balance chemical equation.
CO3: Write electronic configuration of various elements and their ions
CO4: Understanding variation of different parameters in periodic table.
CO5: Conceptualize structure and bonding
CO6: Predict type of Hybridization and shape inorganic molecules and ions
CO7: Evaluate the analytical data
CO8: Apply Law's of thermodynamics to calculate heat of reaction, heat of formation etc.
CO9: Classify and identify colloids and their properties.
CO10: Develop competency skills required for competitive examinations

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

COs	POs/PSOs
CO1	PO2/PSO3
CO2	PO1, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO5,PO8/PSO1
CO5	PO1, PO4, PO7/PSO2
CO6	PO9,PO11/PSO4
CO7	PO4,PO8/PSO1
CO8	PO4,P10/PSO3
CO9	PO4,PO8/PSO4
C10	PO9,PO11/PSO4

BCHC 1901: CHEMISTRY LAB - 1

Objective: This course aims to expose the students to the experimental aspects of standard solution, its preparation and also identification of radicals.

Credits: 02 **Semester I** **L–T–P : 0–0–4**

1. **A.** Prepare a solution N/10 HCl Solution.
   B. Standardize the prepared HCl solution by titrating it against N/20 NaOH solution using phenolphthalein as an internal indicator.
2. **A.** Prepare a standard solution of ferrous ammonium sulphate solution of strength N/30 approximately.
   B. Find out the strength of given ferrous ammonium sulphate solution by titrating it against $KMnO_4$ solution as an intermediate solution.
3. **A.** Preparation of Hypo solution
   B. Prepare a standard solution of copper sulphate of strength N/40 approximately.
   C. Find out the strength of given copper sulphate solution iodometerically by titrating it against Hypo solution as an intermediate solution using starch as an internal indicator.
4. Analyze the following acid radicals in the given salts:
   i) Cl^-, Br^-, I^- (combination),
   ii) NO_3^-, NO_2^- (combination),
   iii) BO_3^{3-}, PO_4^{3-} and removal of interfering radical.
5. Analyze the following acid radicals in the given salts:
   i) CO_3^{2-} , SO_3^{2-} (combination),
   ii) SO_4^{2-}, SO_3^{2-}, S^{2-} (combination),
   iii) CH_3COO^-, NO_2^-, F^-, $C_2O_4^{2-}$ and removal of interfering radical.
6. Analyze the following basic radicals in the given salts: Hg_2^{2+}, Ag^+, Pb^{2+}, Hg^{2+}, Cu^{2+},Cd^{2+}, Bi^{3+}
7. Analyze the following basic radicals in the given salts: As^{3+}, Sb^{3+}, Sn^{2+}, Sn^{4+}, Al^{3+}, Fe^{3+}, Cr^{3+}
8. Analyze the following basic radicals in the given salts: Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}
9. Analyze the following basic radicals in the given salts: Ba^{2+}, Sr^{2+},Ca^{2+}, Mg^{2+}, NH_4^+
10. Analyze the given inorganic mixture containing two acidic and two basic radicals.
11. To determine the relative viscosity of a given liquid with respect to water at room temperature by Ostwald`s viscometer.

Note:

- The mixture may contain more than one basic radicals of same group.
- If the mixture contains any interfering radical then basic radicals of beyond second group may be given.
  The mixture will not contain more than one interfering radical, if present.

Reference/text books:

1. Turpin, G. S. Practical Inorganic Chemistry; General Books, 2009.
2. Vogel, A. I. Textbook of Quantitative Inorganic Analysis, 4th ed.; Longman: London, England, 1978.
3. Vogel, A. I. Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rd ed.; Prentice Hall Press: London, England, 1961.
4. Ahluwalia V K, Dhingra, S., College Practical Chemistry, UniversityPress, Hydrabad, 2015.
5. James, A. M.; Prichard, F. E. Practical Physical Chemistry, 3rd ed.; Prentice Hall Press: London, England, 1974.
6. Firth, J. B. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
7. Findlay, A. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
8. Viswanathan, B. Practical Physical Chemistry; Viva Books: New Delhi, India, 2012.
9. Maity, S. K.; Ghosh, N. K. Physical Chemistry Practical; New Central Book Agency: Delhi, India, 2012.

Focus: This course focuses on employability skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1. Prepare standard and working solutions used in an experiment.
CO2. Analyze acid and basic radicals individually or in mixture.
CO3. Estimate the concentration of ferrous and copper ions from given sample.
CO4. Development of competitive and industry oriented skills

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

COs	POs/PSOs
CO1	PO4/PSO2
CO2	PO3, PO6/PSO6
CO3	PO1, PO2/PSO5
CO4	PO4/PSO2

BPHS 1005: ANCILLARY PHYSICS COURSE – I

Objective: To understand basic principle of applied physics.

Credits: 04 **Semester I** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**wave motion** Type of mechanical wave, wave length, frequency and wave number, progressive harmonic wave, differential equation of wave motion, energy density of plane progressive wave, superposition of wave, beats, propagation of longitudinal and transverse vibration along string, modes of vibration, Fourier's theorem, La'place correction of Newton's formula, group velocity and phase velocity	14
II	**Simple Harmonic Motion** Periodic and harmonic motion, simple harmonic motion, energy of harmonic oscillator, average value of kinetic and potential energy of H.O. mass spring system, two body harmonic oscillator, oscillation of diatomic molecule, time period of pendulum of large amplitude. Kapler's laws and its applications, equation of orbit, anharmonic motion.	14
III	**Damped and forced Harmonic Motion** Frictional effects-(damping), damped harmonic oscillator, power dissipation, quality factor (Q), example of damped H.O, driving (forced) harmonic oscillator, sharpness of resonance, phase of driving Oscillator, Velocity resonance, half width of resonance curve, power absorption. **S**uperposition principle, driving L-C-R circuit, parallel resonance circuit, example and application.	16

Reference Books/ Text Books

1. Physics Part –1, Resanick and Halliday, Wiley Publication.
2. Mechanics, D.S. Mathur, S. Chand & Co., New Delhi.
3. Concept in Physics Vol. I: H.C.Verma, Bharati Bhawan Pub. & Dis-New Delhi.
4. Mechanics: R.K.Shukla and Anchal Srivastava, New Age International (P) Ltd.
5. Classical Mechanics: J.C Upadhyay, Himalaya Publishing House, New Delhi.

Focus: This course focuses on Employability aligned with CO3 and CO6

Outcome:

After studying this course students will able to:

CO1: Understand wave characteristics
CO2: Derive differential equation of wave motion
CO3: State and apply Kepler's Laws
CO4: Distinguish harmonic and anhormonic motion
CO5: Construct harmonic oscillator
CO6: Development of competitive skills

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO2, PO9/PSO4

BPHS 1805: PHYSICS LAB - I

Credits: 02 **Semester I** **L–T–P : 0–0–2**

1. Determination of modulus of rigidity and Poisson's ratio of material of a wire using Searle's method.
2. Determination of Young's modulus of material of metallic bar by bending of beam method.
3. Determination of modulus of rigidity and using Borton's apparatus.
4. Determination of viscosity of liquid using Poiseuille's method.
5. Determination of acceleration due to gravity using compound pendulum.
6. Determination of internal resistance of micro ammeter and conversion of micro ammeter into voltmeter, milliammeter and Ohmmeter.
7. Determination of resistance per unit length and an unknown resistance using C. F. Bridge.
8. To determine specific resistance of wire by Carey Foster Bridge.
9. Determination of absolute capacity of a condenser.
10. To study variation of magnetic field along the axis of Helmholtz Galvanometer and to determine reduction factor.
11. Determination of Energy band gap in a semiconductor diode
12. To study series and parallel resonant L. C. R. circuit.
13. Calibrations of ammeter by potentiometer
14. Calibrations of Voltmmeter by potentiometer

Reference Books/ Text Books

1. B.Sc. Practical Physics, S. Chand & Company Ltd.
2. B.Sc Practical Physics, C.L.Arora, S. Chand & Company Ltd.
3. Pratical Physics, R.K.Shukla and Anchal Srivastava, New Age International (P) Ltd.

Focus: This course focuses on skills development aligned with CO's

Course Outcomes

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

CO1	Apply the various procedures and techniques for the experiments
CO2	Use the different measuring devices and meters to record the data with precision
CO3	Apply the mathematical concepts/equations to obtain quantitative results
CO4	Develop basic communication skills through working in groups in performing the laboratory experiments by interpreting the results

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

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

BMAS 1504: APPLIED MATHEMATICS FOR CHEMISTS

Course Objectives: To make the students understand the concepts of matrices, differentiation, integration and ordinary differential equations by giving more emphasis to their applications in the field of chemistry.

Credits: 04 **Semester I** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Matrices**: Introduction, Inverse by elementary transformations, Rank by Echelon form, Solution of system of linear equations by elementary transformations and Cramer's rule, Eigen values and Eigen vectors, Cayley-Hamilton theorem. **Differential Calculus**: Introduction, Differentiation of elementary functions, Rules of differentiation, Successive differentiation.	20
II	Expansion of functions of one variable, Integration of elementary functions, Methods of integration. **Ordinary Differential Equations:** Introduction, Solution of ODEs of I order and I degree in variable separable and linear forms, Exact differential equations, Solution of n^{th} order linear differential equations with constant coefficients, Applications to problems in Chemistry.	20

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, New Delhi, 2002.

Reference Books:

- W. E. Boyce and R. D. Prima, Elementary Differential Equations, John Wiley & Sons, 2009.
- G. B. Thomas and R. Finney, Calculus & Analytic geometry, Addison Wesley, USA, 1995.

Focus: This course focuses on skills development aligned with CO's

Outcomes:

After studying these topics, the student will be able to

CO1: Find rank, Eigen values and Eigen vectors of a given matrix
CO2: Solve the systems of linear equations
CO3: Learn the concepts of differentiation and integration and to use them in different problems
CO4: Solve the ordinary differential equations and know their applications in chemistry
CO5: Development of competitive skills

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4

CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1/PSO3

BELH 0007: ENGLISH LANGUAGE SKILLS – I

Objective: Keeping in mind the diverse set of students (as far as their mother tongues are concerned) in the undergraduate programmes of the University, this course focuses on communication activities in functional and situational contexts. It encourages students to develop the four skills: reading, writing, listening and speaking. This course also proposes scope for the participants to learn the art of speaking English as standard Indian English speaker without the interference of their mother tongues.

Credits: 03 **Semester I** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours
I	**Grammar**: Parts of Speech: Noun, Pronoun, Adjective, Adverb, Verb; Sentence **Vocabulary**: Word Formation using prefixes & suffixes **Reading:** Study of Text: "The Eyes are not Here" by Ruskin Bond; Comprehension of a given passage from the text **Speaking**: Describing self, persons, places & objects	**12**
II	**Grammar**: Tense; Prepositions, Articles, Subject – Verb Agreement **Vocabulary**: Words often confused **Writing:** Developing a story from given clues **Speaking:** Speaking on need based topics like talking about habits, daily routine, Introducing self & others, likes and dislikes etc.	**12**
III	**Communication**: What is communication? Process of communication; Types and barriers of Communication **Error corrections**: Related to the grammar topics covered in module I & II. **Vocabulary**: Synonyms & Antonyms **Study of Text**: "The Lament" by Anton P. Chekov. Comprehension of a given passage from the text **Speaking:** Role Play and Small Talk	**12**

Prescribed Text: ***An Anthology of Short stories,*** **Ed. RP Singh, Oxford University Press, New Delhi**

References:

1. Wren & Martin, High School English Grammar and Composition, S.Chand& Co. Ltd., New Delhi.
2. Allen, W., Living English Structure, Pearson Education, New Delhi.
3. Collins English Dictionary, Harper Collins Publication Ltd.
4. Longman Dictionary of Contemporary English, Pearson Longman, England.
5. Murphy, Raymond, Intermediate English Grammar, Cambridge University Press.
6. Norman Lewis, Word Power Made Easy, Goyal Publications & Distributers, Delhi.
7. Mohan, Krishan& N.P. Singh, Speaking English Effectively, Macmillan India Ltd., New Delhi.

Audio-Visual Material: **Material available in the language Lab.**

Focus: This course focuses on skills development aligned with CO's

Outcome:

At the end of the course, the participant should be able to

CO1: read articles on subjects of general interest
CO2: review grammar and vocabulary so that one is able to speak & write with more accuracy
CO3: learn the vocabulary and phrases that are widely used.
CO4: practice speaking in groups & communicate in real-life situations.
CO5: Develop competitive skills for different competitive examinations.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO2, PO9/PSO4

BCSO 0005: FUNDAMENTALS OF COMPUTER

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 **Semester I** **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.	9
II.	**Number System:** Bit, Byte, Binary, Decimal, Hexadecimal and Octal number systems and their inter-conversions. **Translator:** Assembler, compiler, interpreter, linker and loader **Introduction to Operating system:** definition, functions, CUI and GUI based operating systems. **Introduction to spreadsheet:** manipulation of cells, formulas and functions, printing of spreadsheet.	9
III.	**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.	8

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.

Text Book:

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

Focus: This course focuses on skills development aligned with CO's

Outcome:

After completion of course, student will be able to:

CO1: Familiar with the basic knowledge of computer.
CO2: Able to use M.S. Office (M.S. Word, M.S. Power point, M.S. Excel and M.S. Access) and Internet efficiently.
CO3: Develop competitive skills.

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

COs	POs/PSOs
CO1	PO3/PSO1
CO2	PO2, PO8/PSO4
CO3	PO3/PSO1

BCSO 0074: FUNDAMENTALS OF COMPUTER LAB

(Open Elective)

Objective: To provide hands-on experience in Microsoft Office tools.

Credits: 01 **Semester I** **L–T–P : 0–0–2**

Content	Lab Hours
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.	24

Focus: This course focuses on skills development aligned with CO's.

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

CO1: Effectively use Microsoft Office tools such as MS Word, MS Excel and Power Point Presentation.

CO2: Develop computer oriented skills.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO1/PSO2

SEMESTER - II

BCHC 0003: ORGANIC CHEMISTRY – I

Objective: This course aims to expose the students to the basics of organic chemistry and to develop concepts to understand advanced organic chemistry.

Credits: 04 **Semester II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Dynamics of Organic Reactions:** Types of organic reactions, energy considerations, detailed study of reaction intermediates (carbocation, carbanion, free radical, carbene, nitrene and arynes). Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects kinetic and stereochemical studies). **Stereochemistry of Organic compounds II: Configurational Analysis:**Optical isomerism - optical activity in molecules with one and more than one stereogenic centers, optical activity in molecules lacking of any chiralcentre (allenes, spiranesalkyledenes and biphenyls) R/S, and D/L nomenclature. Geometric isomerism- geometric isomerism in alkenes, acyclic, oximes and alicyclic compounds and their E & Z system of nomenclature.Conformational analysis - conformational analysis of ethane and n-butane. Difference between configuration and conformation.	16
II	**Alkanes**: Nomenclature, general methods of synthesis (with detailed study of Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical and chemical properties of alkanes with special reference to free radical halogenations of alkanes: orientation, reactivity and selectivity. **Alkenes**: Nomenclature, general methods of synthesis (with special reference to dehydration of alcohols and dehydrohalogenation of alkyl halides). Hofmann elimination and Saytzeff rule, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-(hydrogenation, electrophilic and free radical additions, hydroboration-oxidation, oxymercuration reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$ and polymerisation). Industrial applications of ethylene and propene. Markovnikov's and antiMarkovnikov's rule **Alkynes**: Nomenclature, general methods of synthesis, chemical reactions of alkynes (addition, substitution, oxidation, polymerisation and isomerisation reactions) acidity of alkynes. Industrial applications of ethyne.	16
III	**Arenes:** Nomenclature of benzene derivatives. Structure of benzene: Kekule structure, resonance structure, Huckels rule, stability and carbon-carbon bond lengths in benzene, MO diagram of benzene Energy profile	16

	diagrams. General methods of synthesis of benzene and homologues. Physical and Chemical properties of benzene and its homologues: Rules for aromatic substitution reactions. Aromatic electrophilic substitution reactions (mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction), addition reactions, oxidation reaction. Activating and deactivating substituents in benzene. Orientation. Ortho/para ratio.	

Reference Books:

1. Carey, F. A.; Sundberg, R. J. *Advanced Organic Chemistry: Part A: Structure and Mechanisms*, 3rd ed.; Springer: New York, NY, 2013.
2. Miller, B. *Advanced Organic Chemistry: International Edition*, 2nd ed.; Pearson: Upper Saddle River, NJ, 2004.
3. Bruckner, R. *Advanced Organic Chemistry: Reaction Mechanisms*; Academic Press: San Diego, CA, 2001.
4. Lewis, D. E. *Advanced Organic Chemistry*; Oxford University Press: New York, NY, 2015.
5. March, J. *Advanced Organic Chemistry*, 4th ed.; John Wiley & Sons: Nashville, TN, 1992.

Text Books:

1. Pandit, V. *Advanced Level Organic Chemistry: Questions and Answers*; Vijay Pandit: London, England, 1980.
2. Carey, F. A. *Advanced Organic Chemistry: Part B: Reactions and Synthesis*, 1983rd ed.; Springer: New York, NY, 2013. https://doi.org/10.1007/978-1-4757-1821-8.
3. Mundy, B. P. *Advanced Organic Chemistry*; John Wiley & Sons: Chichester, England, 2010.
4. Sharma, R. R. G. *Advanced Organic Chemistry*; Pacific Books International, 2012.
5. Singh, A.; Singh, R. Textbook of Organic Chemistry; Campus Books International: New Delhi, India, 2005.
6. Tewari, K. S.; etc. A Textbook of Organic Chemistry, 2nd ed.; Sangam Books: London, England, 1999.
7. A Textbook on Organic Chemistry; New Central Book Agency: Delhi, India, 2010.

Focus: This course focuses on employability aligned with CO's.

Outcome:

After studying this course students will able to:

CO1: Name simple and complex organic compounds of family alkane, alkene, alkyne, and aromatic compounds.
CO2: Apply the concept of product analysis, intermediates, isotope effects kinetic and stereochemical studies to determine the reaction mechanism.
CO3: Identify the reaction intermediates such as carbocation, carbanion, free radical, carbene, nitrene and arynes formed during a chemical reaction.
CO4: Propose mechanism for aromatic electrophilic substitution reactions of aromatic compounds.
CO5: Design the mechanistic route for synthesis of various hydrocarbons
CO6: Apply Huckel's rule to predict the aromaticity of organic compounds

CO7: Synthesize derivatives of alkane, alkene, alkyne, and aromatic compounds
CO8: Develop competency in organic chemistry

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO1,PO4/PSO1
CO8	PO3, PO6/PSO5

BCHC 1004: GENERAL CHEMISTRY-II

Objective: This course aims to expose the students to the general aspects of different branches of chemistry which includes nuclear, metallurgy, fuels, water treatment, gaseous acid and bases, chemical equilibrium.

Credits: 04 **Semester II** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**IUPAC** Nomenclature of simple Organic (aliphatic and aromatic) Compounds **Organic Reaction Mechanisms I: Substitution Reactions** (Nucleophilic SN1 and SN2), free radical and electrophilic), addition reactions (electrophilic and free radical) and their mechanisms. Energy profile diagrams and transition state (general considerations). Elimination Reactions, Elimination versus substitution reactions. **Nuclear chemistry:-**Radioactivity: Types and properties of radiations (α, β, and γ rays), Fajan's Soddy group displacement law, rate of radioactivity decay, half life and average life. Artificial radioactivity, stability of nuclei with respect to proton-neutron ratio. Nuclear fusion & nuclear fission. Packing fraction. Carbon dating. Applications of radioactivity. Isotopes and Isobar. **Gaseous State:** Gas laws. Velocity ofGas, average velocity, root mean square velocity, and most probable velocity,Postulates of kinetic theory of gases, derivation of kinetic gas equation and explanation of gas laws from it, deviation of real gases from ideal behavior, van der Waals equation of states, isotherms of CO_2, critical constants and their calculations.	16
II	**Stereochemistry of Organic Compounds-I** Concept of isomerism. Types of isomerism, Configurational isomerism : Optical isomerism-elements of symmetry, molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers, chiral molecules , diastereomers, threo and erythrodiastereomers, meso compounds, Resolution of enantiomers, inversion, retention and racemisation. **Electrochemistry I:** Electrochemical Cells: Galvanic cells, reversible and irreversible cells, experimental determination of emf of a cell. Relation between free energy and emf of reversible cell. Standard hydrogen electrode. Single electrode potential (derivation of Nernst equation) and its measurement. Standard electrode potential. Calculation of emf of reversible cell from electrode potentials. Types of reversible electrodes, Concentration cells.	16

	Chemical equilibrium: Law of mass action, equilibrium constant, relation between K*p*& K*c*, Le Chatelier's principle (effect of concentration, temperature and pressure on equilibrium) **Acids and Bases:**Arrhenius, Brönsted-Lowry, Lewis acid-base concept, Pearson, HSAB concept.	

Reference/ Text Books:

1. Ebbing, D. D.; Gammon, S. D. General Chemistry, 7th ed.; Houghton Mifflin (Trade): Boston, MA, 2001.
2. Barone, S. General Chemistry; Blackwell Science: Oxford, England, 2000.
3. Hill, J. W.; Petrucci, R. H. General Chemistry: An Integrated Approach, 6th ed.; Prentice Hall: Old Tappan, NJ, 1996.
4. McMurry, J. E.; Fay, R. C. General Chemistry: Atoms First: United States Edition; Pearson: Upper Saddle River, NJ, 2009.
5. Umland, J. B.; Bellama, J. M. General Chemistry, 3rd ed.; Brooks/Cole: Florence, KY, 1999.
6. Brady, J. E. General Chemistry: Principles and Structure, 4th ed.; John Wiley & Sons, 1986.
7. Malone, L. J. Basic Concepts of Chemistry, 7th ed.; John Wiley & Sons: Nashville, TN, 2004.
8. Dingle, C. F.; etc. Basic Chemistry, 3rd ed.; Hodder & Stoughton: London, England, 1971.
9. Mallick, A. Engineering Chemistry; Anshan: Royal Tunbridge Wells, England, 2009.
10. Breck, W. G.; etc.; Brown, R. J. C. Chemistry for Science and Engineering; McGraw-Hill: New York, NY, 1981.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Assign the Nomenclature of simple Organic (aliphatic and aromatic) Compounds
CO2: Propose the mechanism for substitution, elimination and addition reactions.
CO3: Apply metallurgical principle in extraction of metals
CO4: Predict the nature of solution, acidic, basic, neutral
CO5: Derive average velocity, root mean square velocity, and most probable velocity
CO6: Evaluate packing fraction and proton-neutron ratio
CO7: Apply Fajan's Soddy group displacement law to identify product in a radioactive change.
CO8: Differentiate strong and week acids.
CO9: Develop competitive skills for different competitive examinations.

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

COs	POs/PSOs
CO1	PO1/PSO3

CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3,PO9/PSO2
CO8	PO1, PO3/PSO4
CO9	PO3, PO6/PSO5

BCHC 1902: CHEMISTRY LAB-II

Objective: This course aims to expose the students to achieve practical expertise on various experiments.

Credits: 02 **Semester II** **L–T–P : 0–0–4**

1. i) To prepare a solution of N/20 potassium dichromate.
   ii) Find out the strength of given $K_2Cr_2O_7$ solution by titrating it against ferrous ammonium sulphate solution as standard solution and using potassium ferricyanide as an external indicator.
2. i) Prepare a standard solution of potassium dichromate of strength N/30 approximately.
   ii) Find out the strength of given potassium dichromate solution iodometrically by titrating it against hypo solution as an intermediate solution using starch as an internal indicator.
3. To prepare Chrome alum $K_2SO_4Cr_2(SO_4)_3.24H_2O$.
4. To prepare Ferrous ammonium sulphate (Mohr`s salt) $FeSO_4.(NH_4)_2SO_4.\ 6H_2O$.
5. To prepare Tetra ammine copper (II) sulphatemonohadrate $[Cu(NH_3)_4]SO_4.H_2O$.
6. To separate the metal ions by paper chromatography.
7. Identification of functional group in a given organic compound. (C=C, CHO, R-CO-R, -COOH, ester).
8. Identification of functional group in a given organic compound. (Phenol, alcohol, carbohydrate, $-NH_2$, $-NO_2$, amide).
9. To determine the relative surface tension of a given liquid with respect to water at room temperature by stalagmometer.

Reference/text books:

1. Turpin, G. S. Practical Inorganic Chemistry; General Books, 2009.
2. Vogel, A. I. Textbook of Quantitative Inorganic Analysis, 4th ed.; Longman: London, England, 1978.
3. Vogel, A. I. Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rd ed.; Prentice Hall Press: London, England, 1961.
4. Ahluwalia V K, Dhingra, S., College Practical Chemistry, UniversityPress, Hydrabad, 2015.
5. James, A. M.; Prichard, F. E. Practical Physical Chemistry, 3rd ed.; Prentice Hall Press: London, England, 1974.
6. Firth, J. B. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
7. Findlay, A. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
8. Viswanathan, B. Practical Physical Chemistry; Viva Books: New Delhi, India, 2012.
9. Maity, S. K.; Ghosh, N. K. Physical Chemistry Practical; New Central Book Agency: Delhi, India, 2012.

Focus: This course focuses on employability and skills development aligned with CO's.

Outcome:

After studying this course students will able to:

CO1: Prepare standard and working solutions used in an experiment.
CO2: Synthesize Chrome alum, Ferrous ammonium sulphate and Tetra ammine copper(II) sulphatemonohadrate.
CO3: Analyze acid and basic radicals individually or in mixture.
CO4: Separate the metal ions by paper chromatography
CO5: Identify functional group in a given organic compound
CO6: Determine the relative surface tension of a given liquid with respect to water at room temperature by stalagmometer.
CO7: Estimate the chloride ion content and hardness in a given sample of water.
CO8: Develop competitive and industry oriented skills.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO5,PO7/PSO1
CO8	PO4,PO8/PSO1

BPHS 1006: ANCILLARY PHYSICS COURSE – II

Objective: This course aims to expose the students to the basic principles of applied physics.

Credits: 04 **Semester II** **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours (Approx.)
I	**(Interference):** Young's experiment, Coherent source, theory of interference fringes, Fresnel biprism, determination of wavelength, Newton's ring,Conditions for sustained interference, Theory of interference, Lloyd's mirror, Achromatic fringes. Interference in parallel and wedge shaped films, Colour of thin films. Newton's rings and Michelson interferometer and their applications. Multiple beam interference in parallel film and Fabry-Perot interferometer.	16
II	**(Diffraction) :** Frenel'sandFraunhofferdiffraction,Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Missing order in double slits and maximum number of order with gratting, plane transmission grating, angular half width of principal maxima Resolving and dispersive power of grating, telescope andMicroscope.	14
III	**(Polarization):** Polarized light and its mathematical representation, Production of polarized light by reflection,refraction and scattering. Polarization by double refraction and Huygen's theory, Nicol prism,Retardation plates, Production and analysis of circularly and elliptically polarized light. Opticalactivity and Fresnel's theory, Biquartzpolarimeter.Basic concepts of Laser, Eisenstein's coefficient.	14

Reference Books/ Text Books

*****1. Physical Optics: B. K. Mathur and T. P. Pandya.
*2. A textbook of Optics: N. Subrahmanyam, Brijlal and M. N. Avadhanulu.
*3. Geometrical and Physical Optics: Longhurst.
*4. Introduction to Modern Optics: G. R. Fowels.
*5. Optics: P. K. Srivastav

Focus: This course focuses on skills development aligned with CO's

Course Outcomes:

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

CO1	Explain theory of interference.
CO2	Discuss interference through double slit, Fresnel biprism and thin film (Constant and varying thickness) and working of Fabry-Perot interferometer.
CO3	Understand phenomenon of diffraction through single, double and N slits.
CO4	Calculate resolving and dispersive power of grating.

CO5	Understand polarization of light, methods for production of polarized light and types of polarized light.
CO6	Familiar with optical activity, Biquartz polarimeter, Laser and Eisenstein's coefficients.

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, PO5,PO6 /PSO1,PSO3
CO3	PO1,PO3, PO5,PO6/PSO1,PSO3
CO4	PO1,PO3, PO4,PO5/PSO1,PSO4
CO5	PO2,PO3, PO7,PO8/PSO1,PSO3
CO6	PO1,PO2, PO7,PO8/PSO1,PSO4

BPHS 1806: PHYSICS LAB – II

Objective: This course aims to expose the students to the practical of applied physics

Credits: 02 **Semester II** **L–T–P : 0–0–4**

1. Determination of Stefan's constant.
2. Determination of temperature coefficient of resistant of material of a given coil.
3. Determination of thermal conductivity of a card board by Lee's Disk method.
4. PN junction diode and Zener diode characteristics.
5. To draw input and output characteristic of p-n-p transistor.
6. Construction of two-input 'OR' and 'AND' gates using diode logic and preparation of their truth tables.
7. Determination of self-inductance of a coil by Anderson's bridge.
8. Determination of focal length of combination of lenses and nodal distance using nodal slide assembly.
9. Determination of specific rotation of Cane Sugar by polarimeter.
10. Determination of Wave Length of sodium yellow line Fresnal'sbiprism.
11. Determination of Wave Length of Mercury Line by diffraction grating.
12. Determination of Wave Length of sodium yellow line by Newton's rings.
13. To determine Diameter/thickness of thin wire by diffraction method.
14. To determine the plank's constant by Wein's radiation formula using an LDR of Photo Cell.

Reference Books/ Text Books

1. Physical Optics: B. K. Mathur and T. P. Pandya.
2. Optics: P. K. Srivastav
3. B.Sc. Practical Physics, S. Chand & Company Ltd.
4. B.Sc Practical Physics, C.L.Arora, S. Chand & Company Ltd.
5. Practical Physics, R.K.Shukla and Anchal Srivastava, New Age International (P) Ltd.

Focus: This course focuses on Skill development aligned with all CO's

Course Outcomes

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

CO1	Apply the various procedures and techniques for the experiments
CO2	Use the different measuring devices and meters to record the data with precision
CO3	Apply the mathematical concepts/equations to obtain quantitative results
CO4	Develop basic communication skills through working in groups in performing the laboratory experiments by interpreting the results

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

COs	POs/ PSOs
CO1	PO1,PO3, PO4/PSO1,PSO3
CO2	PO1,PO2, PO5,PO6/PSO1, PSO4
CO3	PO1,PO2, PO3,PO4/PSO2, PSO3
CO4	PO1,PO7/PSO1,PSO4

BMAS 0505: STATISTICS AND NUMERICAL METHODS

Objectives: To make the students understand the concepts of statistics and numerical methods by giving more emphasis to their applications in chemistry.

Credits: 04 **Semester II** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Statistics I:** Importance of Statistics, Measures of central tendency and Dispersion, Moments, Skewness and Kurtosis by method of moments, Introduction to Probability, Addition and Multiplication theorems of probability. **Statistics II:** Binomial and Poisson distributions, Sampling, Statistical hypotheses, Level of significance, Student's t-test.	20
III	Chi-square test as a test of independence. Correlation and Regression between two variables, Fitting of straight line by method of least squares. **Numerical Methods:** Errors & its types, Bisection and Newton Raphson method, Finite differences, Missing term technique, Interpolation by Newton's forward and divided difference formulae, Numerical integration by trapezoidal and Simpson's rules.	20

Text Books:

- M. Goyaland N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Statistics, Sultan Chand & Sons, Delhi, 2014.

Reference Books:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.

Focus: This course focuses on skills development aligned with CO's

Outcomes:

After studying these topics, the student will be able to

CO1: Fit the straight line to a given data and determine regression lines
CO2: Know probability distributions and the characteristics of frequency distributions
CO3: Solve the problems based on numerical integration
CO4: Learn the concept of sampling and test the hypothesis by Student's t-test
CO5: Develop skills for competitive exams as well as different statistical tests.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1/PSO3

BCHS 0201: ENVIRONMENTAL STUDIES

Objective: *To create awareness towards various environmental issues like global warming, urbanization, pollutions, ozone layer depletion etc; their causes and remedial steps for protecting impacted society.*

Credits: 02 **Semester II** **L-T-P: 2-0-0**

Module No.	Content	Teaching Hours
I	**Basics of Environmental Studies**: Environmental Studies: Introduction, Scope and Importance Environment: Concept, Natural and Anthropogenic Environment Natural Environment: Structure & Function of Atmosphere, Hydrosphere, Lithosphere and Biosphere Ecology and Ecosystem: Definitions Types, Structure & Functions of Ecosystem. Natural Resources: Introduction, Classification, Concept of Conservation Present Status and related to Water Resources, Forest Resources and Mineral Resources.	9
II	**Current Environmental Problems:** Energy Resources: Introduction, Classification, Energy Use Patterns, Energy Crisis, Alternative Energy Resources Present Status and Major Issues Related to Fossil Fuels, Hydroelectricity, Nuclear Energy, Solar Energy and Biomass Energy. Effects of Human Activities on Environment: Effect of Agriculture, Housing, Mining, Transportation and Industries Environment Pollution: Causes, Effects and Control of Air Pollution, Water Pollution, Land Pollution and Noise Pollution Introduction and Management of Solid Wastes and Hazardous Wastes Global Environmental Challenges: Global Warming, Ozone Layer Depletion, Acid Rain, Urbanization, Overpopulation and Biodiversity Depletion.	9
III	**Environmental Protection:** Environmental Protection: Role of Citizens, Role of Government, Initiatives by NGOs, Contribution of International Agencies and Conventions Approaches to Environmental Protection: Public Awareness, Environmental Education, Environmental Ethics, Environmental Laws and Environmental Economics Tools and Strategies: Environmental Impact Assessment, Ecological Footprints and Sustainable Development Efforts towards Environmental Protection in India	8

Text Book:

1. SribastavaSmrti: Environmental Studies, Katson books.

2. Joshi, P.C and Namita Joshi: A textbook of Environment and Ecology, Himalaya Publishing House, 2010
3. Environmental Chemistry: A. K. De; New Age International Publication, 2008.
4. Dhameja, S. K.: Environmental Studies, Katson books.
5. Deswal&Deswal: Environment Ecology, Dhanpat Rai & Co.

Reference Books:

1. Benny Joseph, "Environmental Studies" Tata McGraw-Hill Education.
2. AK De, "Environmental Studies" New Age International Publisher, New Delhi.
3. Shashi K. Singh and Anisha Singh, "Environmental Science & Ecology" A.B. Publication.
4. Agarwal and Sangal, "Environment & Ecology." Krishna's Educational Publisher's Meerut
5. Kates,B.I& White, G.F The Environment as Hazards, oxford, New York, 1978
6. Odum E. P. Fundamentals of Ecology; W. B. Sanders Co. &Natraj (Indian publication), 2011

Focus: This course focuses on skills development aligned with CO's

Outcomes

Students will be able

CO1: To recognize the environmental issues pertaining to daily life; gain awareness for the need of environmental education for sustainable development.
CO2: To acquire knowledge in ecological perspective and value of environment, biotic components, ecosystem process: energy, food chain, water cycle etc.
CO3: To interpret water quality standards and parameters, assessment of water quality, air pollution, pollutants, acid rain, global climate change and greenhouse gases.
CO4: To appreciate the concept of green energy and alternate energy resource for future energy demand.
CO5: To classify the variety of social issues associated with environmental deterioration involving human components including legislative tool such as population, ethics and urban settlements.
CO6: To contribute to create awareness among generation to come and society at large.
CO7: Develop awareness and skills of sustainability of our environment.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3, PO6/PSO5

BELH 0008: English Language Skills-II

Course Objective: The objective of this course is to build up further on the acquired basics of English Language. The syllabus aims to enrich the essential nuances of English grammar, vocabulary, writing skills and comprehension.

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

Module No.	Content	Teaching Hours
I	**Grammar**: Active Passive Voice, Question Tags, Model Auxiliaries **Vocabulary**: One Word Substitutions **Writing**: Formal Application & Letters to editor **Study of Text**: "Science and Human Life" by JBS Haldane; Comprehension of a given passage from the text **Speaking:** Group Discussion.	**12**
II	**Grammar**: Connectives, conditionals **Vocabulary**: Homophones & Homonyms; Phrasal verbs **Writing:** Description of Technical Objects **Speaking:** Words commonly mispronounced.	**12**
III	**Listening**: Importance of listening, Listening & Hearing, Active & Passive Listening and Barriers. **Error Correction:** Related to the grammar topics covered in modules I & II. **Vocabulary**: Technical Vocabulary, Situational Vocabulary **Paragraph Writing**: Principles & Development, writing a paragraph on a topic **Study of Text**: The Heritage of India by A.L. Basham **Speaking:** Power Point Presentation	**12**

Prescribed Text:

- *An Anthology of English Essay,* Ed. RP Singh, Oxford University Press, New Delhi

References:

- Wren & Martin, *High School English Grammar and Composition*, S. Chand & Co. Ltd., New Delhi.
- Allen, W., *Living English Structure*, Pearson Education, New Delhi
- *Collins English Dictionary*, Harper Collins Publication Ltd.
- *Longman Dictionary of Contemporary English*, Pearson Longman, England.
- Murphy, Raymond, *Intermediate English Grammar*, Cambridge University Press.
- Norman Lewis, *Word Power Made Easy*, Goyal Publications & Distributers, Delhi.
- Mohan, Krishan& N.P. Singh, *Speaking English Effectively*, Macmillan India Ltd., New delhi.
- Audio-Visual Material:Material available in the language Lab.

Focus: This course focuses on skill development aligned with CO's.

Learning Outcomes**:** After the completion of this course, the students will be able to:

- Demonstrate a use syntactically correct and effective English.
- Identify common errors of English Language and correct them.
- Evaluate, analyze, comprehend and discuss through textual reading and other reading materials.
- Get prepared to take the next stage of the course in the third semester.

SEMESTER - III

BCHC 0005: PHYSICAL CHEMISTRY – II

Objective: This course aims to develop understanding and conceptual basis of Thermodynamics and Phase Equilibria.

Credits: 04 **Semester III** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**The First Law of Thermodynamics** The first law of thermodynamics, Internal energy, State functions, exact and inexact differentials, Euler reciprocal relation, The cyclic rule, Enthalpy, Heat capacity, Relation between Cp and Cv, Expansion of an ideal gas and changes in thermodynamic properties: (Isothermal expansion, Adiabatic expansion), Final temperatures in reversible and irreversible adiabatic expansions, Comparison of isothermal and adiabatic, Expansions, Reversible isothermal expansion of a real gas, Joule–Thomson effect, Joule–Thomson coefficient in an ideal gas Joule–Thomson coefficient in a real gas, Zeroeth law of thermodynamics, Absolute temperature scale. Change of internal energy in a chemical reaction, Change of enthalpy in a chemical reaction, Exothermic and endothermic reactions, Relation between heats of reaction at constant, volume and at constant pressure, Standard enthalpy changes of reactions, Determination of enthalpies of reactions**,** Variation of enthalpy of a reaction with temperature. The Kirchhoff equation**.**	24
II	**The Second Law of Thermodynamics** Limitations of the first law : Need for the second Law, Spontaneous or irreversible processes, Cyclic process, Carnot cycle, The second law of thermodynamics, Carnot theorem, Concept of entropy, Entropy change in an isothermal expansion of an ideal gas, Entropy changes in reversible and irreversible processes, Entropy changes accompanying changes of phase, Calculation of entropy changes of an ideal gas with change in *P*, *V* and *T*, Entropy of mixing of ideal gases Standard entropies Physical significance of entropy Work and free energy functions Variation of free energy with *T* and *P*,Maxwell's relations Criteria for reversible and irreversible processes.The Third Law of Thermodynamics. **Phase Equilibria** Phase Components, Degree of freedom, Conditions for equilibrium between phases, The Gibbs phase rule, The Derivation of the phase rule One–component systems, Water system, Carbon dioxide system, Sulphur system, Two–component systems (Lead–silver system). Bismuth–cadmium system.	24

Reference Books:

1. Holderness, A. Advanced Level Physical Chemistry; Lazonby, J. N., Series Ed.; Heinemann: Harlow, England, 1976.
2. Kaufman, E. Advanced Concepts in Physical Chemistry; McGraw-Hill: New York, NY, 1966.
3. Bajpal, D. N. Advanced Physical Chemistry: Pt. 3: A Textbook for BSC and Postgraduates; S Chand: New Delhi, India, 2001.
4. Singh, A.; Singh, R. Textbook of Physical Chemistry; Campus Books International: New Delhi, India, 2004.

Text Book

1. Coller, B. A. W.; etc. Principles of Physical Chemistry; Hodder Arnold: London, England, 1978.
2. Pande, V. Physical Chemistry Principles; Rmtk Books, 2012.
3. Rosenberg, R. M. Principles of Physical Chemistry; Oxford University Press: New York, NY, 1977.
4. Hamill, W.; etc. Principles of Physical Chemistry, 2nd ed.; Prentice Hall: Old Tappan, NJ, 1966.

Focus: This course focuses on employability aligned with CO's.

Outcome:

After studying this course students will able to:

CO1: Derive the Relation for Cp and Cv, Joule–Thomson coefficient, Kirchhoff equation, phase rule etc.
CO2: Understand the laws of thermodynamics and various phase systems.
CO3: Calculate work of expansion, compression. entropy changes in reversible and irreversible processes and enthalpy of a reaction
CO4: Apply Maxwell's relations and Criteria for reversible and irreversible processes.
CO5: Deduce laws of thermodynamics, Cyclic Rule, Carnot theorem and Gibbs phase rule
CO6: Evaluate entropy change, enthalpy change, Gibb's free energy change in various theromodynamic process.
CO7: Develop competitive skills for competitive exams.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3, PO6/PSO5

BCHC 1006: ORGANIC CHEMISTRY – II

Objective: This course aims to provide the knowledge to develop concepts of general organic chemistry, cyclic organic compounds, and compounds of halogen, O, S and N.

Credits: 04 **Semester III** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**CHEMISTRY OF ALIPHATIC HYDROCARBONS** **A. Carbon-Carbon sigma bonds** Formation of alkanes: Wurtz Reaction, Wurtz-Fittig Reactions, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids Free radical substitutions: Halogenation-relative reactivity and selectivity. **B. Carbon-Carbon pi bonds** Formation of alkenes and alkynes by elimination reactions. **Reactions of alkenes and cycloalkenes:** Electrophilic additions and their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2- and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction; Allylic and benzylic bromination and mechanism. **Reactions of alkynes:** Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes**.** **C. Cycloalkanes and Conformational Analysis** **Cycloalkanes:** Types, preparation reactions of cycloalkanes and their relative stability, Baeyer strain theory **AROMATIC HYDROCARBONS** Method of preparation of aromatic hydrocarbons,Electrophilic aromatic substitution: halogenation, nitration, sulphonation, and Friedel-Craft's alkylation/ acylation with their mechanism. Directing effects of the groups.	24
II	**CHEMISTRY OF HALOGENATED HYDROCARBONS** **Alkyl halides and Aryl halides:** Preparation, including preparation from diazonium salts. Nucleophilic aromatic substitution; SNAr, Benzyne mechanism Relative reactivity of Alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. **Organometallic compounds**: Of Mg and Li – Use in synthesis of organic compounds. **ALCOHOLS, PHENOLS, ETHERS AND EPOXIDES** **Alcohols:** Preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols : Oxidation of diols by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement; **Phenols:** Preparation and properties; Acidity and factors affecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism; **Ethers and Epoxides:** Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$ **Sulphur containing compounds:** Preparation and reactions of thiols, thioethers and sulphonic acids.	24

Reference Books:

1. Carey, F. A.; Sundberg, R. J. *Advanced Organic Chemistry: Part A: Structure and Mechanisms*, 3rd ed.; Springer: New York, NY, 2013.
2. Miller, B. *Advanced Organic Chemistry: International Edition*, 2nd ed.; Pearson: Upper Saddle River, NJ, 2004.
3. Bruckner, R. *Advanced Organic Chemistry: Reaction Mechanisms*; Academic Press: San Diego, CA, 2001.
4. Lewis, D. E. *Advanced Organic Chemistry*; Oxford University Press: New York, NY, 2015.
5. March, J. *Advanced Organic Chemistry*, 4th ed.; John Wiley & Sons: Nashville, TN, 1992.

Text Books:

1. Pandit, V. *Advanced Level Organic Chemistry: Questions and Answers*; Vijay Pandit: London, England, 1980.
2. Carey, F. A. *Advanced Organic Chemistry: Part B: Reactions and Synthesis*, 1983rd ed.; Springer: New York, NY, 2013. https://doi.org/10.1007/978-1-4757-1821-8.
3. Mundy, B. P. *Advanced Organic Chemistry*; John Wiley & Sons: Chichester, England, 2010.
4. Sharma, R. R. G. *Advanced Organic Chemistry*; Pacific Books International, 2012.
5. Singh, A.; Singh, R. Textbook of Organic Chemistry; Campus Books International: New Delhi, India, 2005.
6. Tewari, K. S.; etc. A Textbook of Organic Chemistry, 2nd ed.; Sangam Books: London, England, 1999.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Name, simple or complex alkane, alkene, alkyne, cycloalkane, Cycloalkane dienes, alkyhalide, and O and S- containing compounds.
CO2: Draw conformations of Cycloalkanes
CO3: Cyclic organic compounds, alkyl and halide, o and s –containing compounds.
CO4: Propose Mechanism for organic reactions.
CO5: Design the mechanistic route for working of oxidizing and reducing agent.
CO6: Develop competitive skills.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO3, PO6/PSO5

BCHC 1007: INORGANIC CHEMISTRY – I

Objective: This course aims to develop fundamental concepts of s, p and d block elements.

Credits: 04 **Semester III** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Chemistry of s-block elements:** The general trends in the chemistry of s-block elements; describe the trends in physical and chemical properties of group 1 & 2 elements. Anomalous behavior of Li and Be. Manufacturing process, properties and industrial applications of sodium and calcium compounds– NaOH, Na_2CO_3, $NaHCO_3$, $CaCO_3$, $Ca(OH)_2$, Plaster of Paris, Portland **Chemistry of p-block elements:** The general trends in the chemistry of p-block elements; describe the trends in physical and chemical properties of group 13-17 elements, Anomalous behavior of boron. Allotropes of carbon. a) Group trends with reference to electronic configuration, size, and oxidation states and in compounds such as hydrides, oxides, oxyacids, b) Preparation, properties, bonding, stereochemistry and uses of following except where specific aspects are mentioned i) Borax, Orthoboric acid, Diboranes and Boron nitrides its oxidizing behaviour. ii) SiO_2, Silicones, Silicates, Zeolites. iii) Basics of Peracids of sulphur and halogens	24
II	**Chemistry of Elements ofd-block elements:** General characteristic properties– ionic radii, oxidation states, complexation tendency, magnetic behavior and electronic spectral properties. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry.	24

Reference Books:

1. Lee, J. D. Concise Inorganic Chemistry, 4th ed.; Chapman and Hall: London, England, 1991.
2. Chandra, S. Concise Inorganic Chemistry; I K International Publishing House: New Delhi, India, 2011.
3. Thakur, O. P. CONCISE INORGANIC CHEMISTRY; Amiga Press: Delhi, India, 2018.
4. Lowrie, R. S. Concise Notes in Inorganic Chemistry; Pergamon Press: London, England, 1965.
5. Ganguly, A. Fundamentals of Inorganic Chemistry; Pearson, 2010.

Text Books:

1. Cotton, F. A.; Wilkinson, G.; Murillo, C. A.; Bochmann, M. Advanced Inorganic Chemistry, 6th ed.; John Wiley & Sons: Nashville, TN, 1999.
2. Durrant, P. J.; Durrant, B. Introduction to Advanced Inorganic Chemistry, 2nd ed.; Prentice Hall Press: London, England, 1972.
3. Rastogi, A. Advanced Inorganic Chemistry; Anmol Publications: New Delhi, India, 2010.
4. Choudhary, N. L. Fundamentals of Inorganic Chemistry; Shree Publishers & Distributors: New Delhi, India, 2020.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the general trends of periodic properties of s, p, and d block elements.
CO2: Identify the applications of compounds of s, p, and d block elements.
CO3: Predict the hybridization, shapes and structure of oxides, oxy acids, halides, silicates and other inorganic compounds of s, p, and d block elements
CO4: Compare the trends of properties of first, second and third transition series.
CO5: Predict the magnetic behavior of compounds of 3d, 4d and 5d series.
CO6: Highlight the anomalous behavior of elements of s, p, and d block elements
CO7: Synthesize inorganic compounds of s, p, and d block elements.
CO8: Develop competitive skills for different competitive examinations.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO9,PO11/PSO3
CO8	PO4,PO8/PSO1

BCHC0903: CHEMISTRY LAB - III

Objective: This course aims to have practical exposure and hand on expertise on experiments of physical chemistry.

Credits: 02 **Semester III** **L–T–P : 0–0–4**

(A) Acid- Base Titrations

(i) **a.** Preparation of samples

b. Estimation of carbonate and hydroxide present together in mixture.

(ii) **a**. Preparation of samples

b. Estimation of carbonate and bicarbonate present together in a mixture.

(iii) **a.** Preparation of samples

b. Estimation of free alkali present in different soaps/detergents

(B) Oxidation- Reduction Titrimetry

(i) **a.** Standardization of $KMnO_4$ solution

b. Estimation of oxalic acid using standardized KMnO4 solution.

(ii) **a.** Standardization of NaOH solution

b. Estimation of oxalic acid and sodium oxalate in a given mixture.

(iii) **a.** Preparation and Standardization of $K_2Cr_2O_7$

b. Estimation of Fe (II) with $K_2Cr_2O_7$ using diphenylamine as internal indicator

(iv) **a.** Preparation and Standardization of $K_2Cr_2O_7$

b. Estimation of Fe (II) with $K_2Cr_2O_7$ using anthranilic acid as internal indicator

(C) Iodo / Iodimetric Titrations

i. Estimation of Cu (II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).

ii. Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically

iii. Estimation of available chlorine in bleaching powder iodometrically.

(D) **Argentometric titrations**

Estimation of Cl^- (i) By Mohr's method, (ii) By Vohlard's method, (iii) By Fajan's method.

NOTE: All the safety measures or steps for the all the respective experiments must be taken care strictly

Reference text:

1. James, A. M.; Prichard, F. E. Practical Physical Chemistry, 3rd ed.; Prentice Hall Press: London, England, 1974.
2. Firth, J. B. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
3. Findlay, A. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
4. Viswanathan, B. Practical Physical Chemistry; Viva Books: New Delhi, India, 2012.
5. Maity, S. K.; Ghosh, N. K. Physical Chemistry Practical; New Central Book Agency: Delhi, India, 2012.
6. Viswanathan, B.; Raghavan, P. S. Practical Physical Chemistry; Viva Books: New Delhi, India, 2014.
7. Gray, F. W. A Manual of Practical Physical Chemistry; Rarebooksclub.com, 2012.

8. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
9. Ahluwalia V K, Dhingra, S., College Practical Chemistry, University Press, Hydrabad, 2015.
10. B. Viswanathan, P. S. Raghavan, Practical Physical Chemistry, Viva Books Private Limited, 2010.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Prepare standard and working solutions used in an experiment.
CO2: Estimate the carbonate, bi-carbonate and hydroxide ion in a given sample.
CO3: Determine the ferrous ion using redox titrimetry.
CO4: Quantify copper, arsenite and antimony using Iodo / Iodimetric Titrations
CO5: Evaluate Cl^- by Mohr's method, Vohlard's method and Fajan's method
CO6: Develop competitive as well as industry oriented skills.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO2, PO9/PSO4

BCHC0904: CHEMISTRY LAB – IV

Objective: This course aims to have practical exposure and hand on expertise on experiments of organic chemistry.

Credits: 02 **Semester III** **L–T–P : 0–0–4**

1. **a.** Checking the calibration of the thermometer
   b. determines the melting point of few organic compounds
2. Purification of organic compounds by crystallization using the following solvents:
   a. Water
   b. Alcohol
   c. Alcohol-Water
3. **a.** Determination of the melting points of above compounds and unknown organic compounds using Kjeldahl method.
   b. Determination of the melting points of above compounds and unknown organic compounds using electrically heated melting point apparatus
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100° C by distillation and capillary method)
6. Chromatography

a. i) Preparation of samples
   ii) Separation of a mixture of two amino acids by ascending and horizontal paper chromatography

b. i) Preparation of samples
   ii) Separation of a mixture of two sugars by ascending paper chromatography

c. i) Preparation of TLC plates
   ii) Separation of a mixture of o- and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC)

d. i) Preparation of sugar solution
   ii) identification of the monosaccharides present in the given mixture
   iii) Separation of monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Report the Rf values.

NOTE: <u>All the safety measures or steps for the all the respective experiments must be taken care strictly</u>

Reference/text books:

1. Ahluwalia, V. K.; Aggarwal, R.; Alluwalia, V. K. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis; Sangam Books: London, England, 2001.
2. Mann, F. G.; Saunders, B. C. Practical Organic Chemistry; Longman: London, England, 1979.
3. Practical Organic Chemistry: A Student Handbook of Techniques, 1989th ed.; Sharp, J. T., Ed.; Springer: Dordrecht, Netherlands, 1989.
4. Ahluwalia, V. K.; Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis; Sangam Books: London, England, 2001.
5. Procter, G.; Leonard, J.; Casey, M.; Lygo, B. Advance Practical Organic Chemistry, 1990th ed.; Nelson Thornes: Cheltenham, England, 1989.
6. Procter, G.; Leonard, J.; Casey, M.; Lygo, B. Advance Practical Organic Chemistry, 1990th ed.; Nelson Thornes: Cheltenham, England, 1989.
7. Practical Synthetic Organic Chemistry: Reactions, Principles, and Techniques, 1st ed.; Caron, S., Ed.; John Wiley & Sons: Nashville, TN, 2011.
8. Casey, M.; etc. Advanced Practical Organic Chemistry, 2nd ed.; Nelson Thornes: Cheltenham, England, 1994.
9. Vogel, A. I. Textbook of Practical Organic Chemistry, 4th ed.; Longman: London, England, 1978.
10. Leonard, J.; Lygo, B.; Procter, G. Advanced Practical Organic Chemistry, 3rd ed.; CRC Press: Boca Raton, FL, 2013.

11. Vogel, A. I. Elementary Practical Organic Chemistry: Preparations Pt. 2, 3rd ed.; Smith, B. V., Waldron, N. M., Series Eds.; Prentice Hall Press: London, England, 1980.
12. Vogel, A. I.; Tatchell, A. R.; Furnis, B. S.; Hannaford, A. J.; Greig- Smith, P. W. Vogel's Textbook of Practical Organic Chemistry, 5th ed.; Prentice-Hall: London, England, 1989.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Check the calibration of the thermometer to determine the melting point of organic compounds
CO2: Determine of the melting points using Kjeldahl method and boiling point of liquid compounds by distillation and capillary method
CO3: Prepare standard and working solutions used in paper chromatography.
CO4: Separate mixture of organic compounds by paper chromatography
CO5: Develop competitive as well as industry oriented skills.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO2, PO9/PSO4

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BCHC0905: CHEMISTRY LAB - V

(Inorganic 1)

Objective: This course aims to provide practical exposure and hand on expertise of experiments of inorganic chemistry.

Credits: 02 **Semester III** **L–T–P : 0–0–4**

Inorganic preparations:

(i) **a.** Preparation of Cuprous Chloride, Cu_2Cl_2
b. Re-crystallization of prepared compounds
(ii) **a.** Preparation of Manganese (III) phosphate, $MnPO_4.H_2O$
b. Re-crystallization of prepared compounds
(iii) **a.** Preparation of Aluminium Potassium sulphate [$KAl(SO_4)_2.12H_2O$] (Potash alum)
b. Re-crystallization of prepared compounds
(iv) a. Preparation of Chrome alum
b. Re-crystallization of prepared compounds

Complexometric Titrations

i. **a.** Complexometric estimation of Mg^{2+} using EDTA
b. Complexometric estimation of Zn^{2+} using EDTA
ii. **a.** Standardization of EDTA solution
b. Estimation of total hardness of water samples
iii. **a.** Standardization of EDTA solution
b. Estimation of Ca^{2+} in solution by (substitution method) using EBT as indicator
iv**) a.** Standardization of EDTA solution
b. Estimation of Ca/Mg in drugs and Biological samples

Paper Chromatographic: separation of Ni (II) and Co(II); Cu(II) and Cd (II)C

NOTE: All the safety measures or steps for the all the respective experiments must be taken care strictly

Reference/text books:

1. Jago, W. Inorganic Chemistry, Theoretical and Practical, an Elementary Text-Book; Rarebooksclub.com, 2012.
2. Turpin, G. S. Practical Inorganic Chemistry; General Books, 2009.
3. Vogel, A. I. Textbook of Quantitative Inorganic Analysis, 4th ed.; Longman: London, England, 1978.
4. Vogel, A. I. Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rd ed.; Prentice Hall Press: London, England, 1961.
5. Ahluwalia V K, Dhingra, S., College Practical Chemistry, UniversityPress, Hydrabad, 2015.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Check the calibration of the thermometer to determine the melting point of organic compounds
CO2: Determine of the melting points using Kjeldahl method and boiling point of liquid compounds by distillation and capillary method

CO3: Prepare Cu2Cl2, MnPO4.H2O, Potash alum, Chrome alum
CO4: Separate mixture of inorganic salts by paper chromatography
CO5: Estimate Ca/Mg in drugs and Biological samples, hardness of water, Zn^{2+} in a given sample.
CO6: Develop competitive as well as industry oriented skills.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO1, PO4/PSO4
CO3	PO3, PO5/PSO3
CO4	PO4,PO6/PSO1
CO5	PO1, PO5, PO10/PSO4
CO6	PO1, PO4/PSO4

SEMESTER - IV

BCHC 0008: PHYSICAL CHEMISTRY – III

Objective: This course aims to develop understanding and conceptual basis of Electrochemistry and Solid State.

Credits: 04 **Semester IV** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Electrochemistry Part I: Introduction (**Electrolytic conductance, Specific conductance, Equivalent conductance, Molar conductance, Variation of molar conductance with dilution, Ionic mobility), Hittorf's theoretical device, Transport number, Determination of transport numbers, Hittorf's method, Moving boundary method, Kohlrausch's law, Calculation of molar ionic conductance, Relation between molar Ionic conductance and ionic mobility, Determination of ionic mobility, Applications of Kohlrausch's law, Diffusion and ionic mobility, Applications of conductance measurements, Conductometric titrations, Precipitation titrations, Ostwald's dilution law **Electrochemistry Part II:** Debye–Hückel theory of strong electrolytes, Debye–Hückel limiting law, Ionic strength, Mean ionic activity, Concentration cells-Electrode and Electrolyte–concentration cells, Types of electrolyte concentration cells, Concentration cells without transference, Concentration cells with transference, Liquid junction potential, Fuel cells. Applications of EMF measurements.	24
II	**The Solid State:**Difference between crystalline and amorphous, solids, Symmetry in crystal systems, Point groups and space groups, Space lattice and the unit cell, Bravais lattices, Seven crystal systems, Lattice energy of an ionic crystal, Law of rational indices, Miller indices, Interplanar spacing in a crystal system, X–ray diffraction, The Bragg equation, Imperfections in a crystal, Point defects, Schottky defects, Frenkel defects, Colourcenters, Line defects: Dislocations, Imperfections due to transient atomic displacement.	24

Reference Books:

1. Hofmann, A. Physical Chemistry Essentials, 1st ed.; Springer International Publishing: Basel, Switzerland, 2018.
2. Lones, L. Essentials of Physical Chemistry; Createspace Independent Publishing Platform: North Charleston, SC, 2017.
3. Shillady, D. Essentials of Physical Chemistry; CRC Press: Boca Raton, FL, 2011.
4. Essentials of Physical Chemistry; Miller, F., Ed.; NY Research Press, 2017.
5. Bahl, B. S.; Tuli, G. D.; Bahl, A. Essentials of Physical Chemistry, 24th ed.; S Chand: New Delhi, India, 2000.
6. Gurtu, J. N.; Gurtu, A. Advanced Physical Chemistry Experiments; PragatiPrakashan, 2008.
7. Advanced Series in Physical Chemistry; World Scientific Publishing Company, 2012.

Text Book

1. Woldeamanuel, M. M. Text Book of Physical Chemistry for Science and Engineering Students; LAP Lambert Academic Publishing, 2019.
2. Waldeck, D. H.; Kuhn, H.; Forsterling, H.-D. Principles of Physical Chemistry; John Wiley & Sons: Nashville, TN, 2013.
3. Raff, L. M. Principles of Physical Chemistry; Pearson: Upper Saddle River, NJ, 2001.

4. Atkins, P. W.; Clugston, M. J. Principles of Physical Chemistry; Pitman Publishing: Harlow, England, 1982.
5. Coller, B. A. W.; etc. Principles of Physical Chemistry; Hodder Arnold: London, England, 1978.
6. Mallick, A. Principles of Physical Chemistry; MV Learning, 2018.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Determine the Electrolytic conductance, Specific conductance, Equivalent conductance, Molar conductance, Variation of molar conductance with dilution, Ionic mobility and transport numbers etc.
CO2: Derive the expression for Ionic conductance and ionic mobility.
CO3: Understand the Debye–Hückel theory of strong electrolytes.
CO4: Identify the point groups, space groups, space lattice, unit cell, Bravais lattices and seven crystal systems
CO5: Calculate Miller indices and Interplanar spacing in a crystal system
CO6: Deduce Kohlrausch's law, Ostwald's dilution law, Law of rational indices
CO7: Develop competitive skills.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO2, PO9/PSO4

BCHC 0009: ORGANIC CHEMISTRY – III

Objective: To impart fundamental concepts and applications of Carbonyl and Nitrogen Containing Compounds.

Credits: 04 **Semester IV** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Carbonyl Compounds:** Naming, Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagelcondensation,Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition. **Active methylene compounds:**Keto-enoltautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate:	24
II	**Carboxylic Acids and their Derivatives:** Naming, Preparation, physical properties and reactions of monocarboxylic acids:Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group - Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement **Nitrogen Containing Functional Groups:** Naming, Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1^0, 2^0 and 3^0 amines with Hinsberg reagent and nitrous acid; Diazonium Salts: Preparation and their synthetic applications.	24

Reference Books:

1. Carey, F. A.; Sundberg, R. J. *Advanced Organic Chemistry: Part A: Structure and Mechanisms*, 3rd ed.; Springer: New York, NY, 2013.
2. Miller, B. *Advanced Organic Chemistry: International Edition*, 2nd ed.; Pearson: Upper Saddle River, NJ, 2004.
3. Bruckner, R. *Advanced Organic Chemistry: Reaction Mechanisms*; Academic Press: San Diego, CA, 2001.
4. Lewis, D. E. *Advanced Organic Chemistry*; Oxford University Press: New York, NY, 2015.
5. March, J. *Advanced Organic Chemistry*, 4th ed.; John Wiley & Sons: Nashville, TN, 1992.

Text Books:

1. Pandit, V. *Advanced Level Organic Chemistry: Questions and Answers*; Vijay Pandit: London, England, 1980.
2. Carey, F. A. *Advanced Organic Chemistry: Part B: Reactions and Synthesis*, 1983rd ed.; Springer: New York, NY, 2013. https://doi.org/10.1007/978-1-4757-1821-8.
3. Mundy, B. P. *Advanced Organic Chemistry*; John Wiley & Sons: Chichester, England, 2010.
4. Sharma, R. R. G. *Advanced Organic Chemistry*; Pacific Books International, 2012.
5. Singh, A.; Singh, R. Textbook of Organic Chemistry; Campus Books International: New Delhi, India, 2005.
6. Tewari, K. S.; etc. A Textbook of Organic Chemistry, 2nd ed.; Sangam Books: London, England, 1999.
7. A Textbook on Organic Chemistry; New Central Book Agency: Delhi, India, 2010.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Name simple and complex organic compounds containing carbonyl groups.
CO2: Apply various reactions such as condensation, oxidation and reduction to design new organic compounds.
CO3: Propose mechanism for synthetic routes for various organic compounds.
CO4: Design the synthesis of O- and N- containing organic compounds
CO5: Differentiate 1^0, 2^0 and 3^0 amines and alcohols
CO6: Identify the name of a reaction and its mechanistic routes.
CO7: Develop competitive skills for different competitive examinations.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3, PO6/PSO5

BCHC 1010: INORGANIC CHEMISTRY – II

Objective: To develop basic knowledge and applications of Coordination Chemistry, Lanthanoids & actinoids and Bioinorganic Chemistry.

Credits: 04 **Semester IV** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Lanthanoids and actinoids**: electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only). **Coordination Chemistry** Werner's theory, valence bond theory (inner and outer orbital complexes), Electro-neutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination, IUPAC nomenclature of coordination compounds, isomerism in coordinationcompounds. Optical activity of metal complexes and complexes with chiral ligands. Chelate effect, polynuclear complexes, Labile and inert complexes.	24
II	**Bioinorganic Chemistry:** Metal ions present in biological systemslikeheme and non-hemeproteins,cytochrome P-450, carbonic anhydrase, carboxypeptidase, and Fe-S proteins. Classification of elements according to their action in biological system. Sodium / K-pump, Excess and deficiency of some trace metals. Toxicity of metalions (Hg, Pb, Cd and As), reasons for toxicity.	24

Reference Books:

1. Lee, J. D. Concise Inorganic Chemistry, 4th ed.; Chapman and Hall: London, England, 1991.
2. Chandra, S. Concise Inorganic Chemistry; I K International Publishing House: New Delhi, India, 2011.
3. Thakur, O. P. CONCISE INORGANIC CHEMISTRY; Amiga Press: Delhi, India, 2018.
4. Lowrie, R. S. Concise Notes in Inorganic Chemistry; Pergamon Press: London, England, 1965.
5. Ganguly, A. Fundamentals of Inorganic Chemistry; Pearson, 2010.

Text Books:

1. Cotton, F. A.; Wilkinson, G.; Murillo, C. A.; Bochmann, M. Advanced Inorganic Chemistry, 6th ed.; John Wiley & Sons: Nashville, TN, 1999.
2. Durrant, P. J.; Durrant, B. Introduction to Advanced Inorganic Chemistry, 2nd ed.; Prentice Hall Press: London, England, 1972.
3. Rastogi, A. Advanced Inorganic Chemistry; Anmol Publications: New Delhi, India, 2010.
4. Choudhary, N. L. Fundamentals of Inorganic Chemistry; Shree Publishers & Distributors: New Delhi, India, 2020.

Focus: This course focuses on employability aligned with CO's

Outcome:
After studying this course students will able to:

CO1: Understand the crystal properties, Δo, Δt, size effect of CFSE for coordination complexes.
CO2: Differentiate inner and outer sphere coordination complexes.
CO3: Assign IUPAC nomenclature of coordination compounds
CO4: Predict the nature, optical and spectral properties of coordination compounds
CO5: Highlight the chemistry of Lanthanoids and actinoids in terms of electronic, magnetic and spectral properties.
CO6: Analyze the mixture of cation and anion in organic salt.
CO7: Identify the toxicity and use of heavy metals.
CO8: Classify the elements in biological system.
CO9: Develop competitive skills.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO4/PSO4
CO3	PO3, PO6/PSO5
CO4	PO2,PO1/PSO1
CO5	PO1, PO3, PO7/PSO2
CO6	PO4,PO8/PSO1
CO7	PO1, PO5, PO7/PSO2
CO8	PO10,PO11/PSO4
CO9	PO2,PO1/PSO1

BCHC 0906: CHEMISTRY LAB - VI

(Physical 2)

Objective: This course aims to provide practical exposure in order to gain hand on expertise on experiments of physical chemistry.

Credits: 02 **Semester IV** **L–T–P : 0–0–4**

I. To study changes in conductance in the following systems

(i) **a.** Preparation of stock solution

b. Conductometric measurement of mixture ofstrong acid-strong base

(ii) **a.** Preparation of stock solution

b. Conductometric measurement of mixture ofweak acid-strong base

(iii) **a.** Preparation of stock solution

b. Conductometric measurement ofmixture of strong acid and weak acid-strong base

II. Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction

2. Integrated rate method:

(a) Acid hydrolysis of methyl acetate with hydrochloric acid, volumetrically or conductometrically.

(b) Iodide-persulphate reaction

(c) Saponification of ethyl acetate.

NOTE: All the safety measures or steps for the all the respective experiments must be taken care strictly

Reference / Text books:

1. Amita D., Practical Physical Chemistry, Ane Books, Ed 1, 2018.
2. James, A. M.; Prichard, F. E. Practical Physical Chemistry, 3rd ed.; Prentice Hall Press: London, England, 1974.
3. Firth, J. B. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
4. Findlay, A. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
5. Viswanathan, B. Practical Physical Chemistry; Viva Books: New Delhi, India, 2012.
6. Maity, S. K.; Ghosh, N. K. Physical Chemistry Practical; New Central Book Agency: Delhi, India, 2012.
7. Viswanathan, B.; Raghavan, P. S. Practical Physical Chemistry; Viva Books: New Delhi, India, 2014.
8. Gray, F. W. A Manual of Practical Physical Chemistry; Rarebooksclub.com, 2012.
9. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
10. Ahluwalia V K, Dhingra, S., College Practical Chemistry, UniversityPress, Hydrabad, 2015.
11. B. Viswanathan, P. S. Raghavan, Practical Physical Chemistry, Viva Books Private Limited, 2010.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Verify Initial rate method and Integrated rate method volumetrically or conductometrically

CO2: Determine of the melting points using Kjeldahl method and boiling point of liquid compounds by distillation and capillary method

CO3: Prepare standard and working solutions for titrimetric analysis.

CO4: Estimate the concentration of acid or base using conductometric titration

CO5: Develop competitive and industry oriented skills.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO2, PO9/PSO4

BCHC 0907: CHEMISTRY LAB - VII

Objective: To provide practical exposure and hand on expertise on experiments of organic chemistry.

Credits: 02 **Semester IV** **L–T–P : 0–0–4**

1. Systematic analysis of extra elements in the given unknown compounds
2. Tests for functional groups and unsaturation
3. Qualitative analysis of the following types of unknown organic compounds:
   Carboxylic acids, Phenols, Alcohols, Aldehydes, Ketones, Esters

Organic Preparations **(**Conventional and green synthesis**)**

1. Diels-Alder reaction between anthracene and maleic anhydride
2. Reduction: nitrobenzene to azobenzene (TLC of the mixture), m-dinitrobenzene to m-nitroaniline
3. S-benzylisothiuranum salts of any one water soluble and one water insoluble acid: acetic acid, phenyl acetic acid, oxalic acid, benzoic acid, phthalic acid
4. Green method of reduction of benzophenone to benzopinacol
5. Benzoin condensation of benzaldehyde (using thiamine hydrochloride)
6. Sovent less condensation of p-toluidine with benzaldehyde/salicylaldehyde/2-hydroxy-3-methoxybenzadehyde to get Schiff's base (solventless condensation)
7. Nitration and acylation of aromatic compounds

NOTE: All the safety measures or steps for all the respective experiments must be taken care of strictly.

Reference/text books:

1. Ahluwalia, V. K.; Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis; Sangam Books: London, England, 2001.
2. Procter, G.; Leonard, J.; Casey, M.; Lygo, B. Advance Practical Organic Chemistry, 1990th ed.; Nelson Thornes: Cheltenham, England, 1989.
3. Procter, G.; Leonard, J.; Casey, M.; Lygo, B. Advance Practical Organic Chemistry, 1990th ed.; Nelson Thornes: Cheltenham, England, 1989.
4. Practical Synthetic Organic Chemistry: Reactions, Principles, and Techniques, 1st ed.; Caron, S., Ed.; John Wiley & Sons: Nashville, TN, 2011.
5. Vogel, A. I. Textbook of Practical Organic Chemistry, 4th ed.; Longman: London, England, 1978.
6. Vogel, A. I. Elementary Practical Organic Chemistry: Preparations Pt. 2, 3rd ed.; Smith, B. V., Waldron, N. M., Series Eds.; Prentice Hall Press: London, England, 1980.
7. Vogel, A. I.; Tatchell, A. R.; Furnis, B. S.; Hannaford, A. J.; Greig- Smith, P. W. Vogel's Textbook of Practical Organic Chemistry, 5th ed.; Prentice-Hall: London, England, 1989.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Detect extra elements in given unknown compounds
CO2: Testify functional groups and unsaturation present in unknown compounds
CO3: Analyze unknown organic compounds like Carboxylic acids, Phenols, Alcohols, Aldehydes, Ketones, Esters
CO4: Synthesize Nitro and acylated derivatives of aromatic compounds

CO5: Carry out conventional and green synthesis of organic compounds
CO6: Develop competitive skills and the skills based on industrial production.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO4,PO8/PSO1

BCHC 0908: CHEMISTRY LAB - VIII

(Inorganic 2)

Objective: To provide practical exposure to gain necessary expertise on experiments of inorganic chemistry for estimation of acidic and basic radicals.

Credits: 02 **Semester IV** **L–T–P : 0–0–4**

Qualitative analysis:

Using H_2S /PTC/ Thioacetamide or any other reagent. Identification of cations and simple anions in a mixture of salts containing not more than six ions (Three cations and three anions) interfering anions using semi-micro scheme of analysis. If combination of cations or anions is given in the mixture, insoluble should be avoided. Spot tests should be carried out for final identifications wherever feasible.

Cation: Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, As^{3+}, Sb^{3+}, Sn^{2+} or Sn^{4+}, Fe^{2+} OR Fe^{3+}, Al^{3+}, Cr^{3+},Co^{2+}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH_4^+, K^+

Anion: CO_3^{2-}, SO_3^{2-}, SO_3^{2-}, S^{2-}, $NO2^-$, CH_3COO^-, NO_3^-, Cl^-, Br^-, I^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, F^-, $C_2O_2^{-4}$

NOTE: All the safety measures or steps for all the respective experiments must be taken care of strictly.

Reference/text books:

1. Jago, W. Inorganic Chemistry, Theoretical and Practical, an Elementary Text-Book; Rarebooksclub.com, 2012.
2. Turpin, G. S. Practical Inorganic Chemistry; General Books, 2009.
3. Vogel, A. I. Textbook of Quantitative Inorganic Analysis, 4th ed.; Longman: London, England, 1978.
4. Vogel, A. I. Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rd ed.; Prentice Hall Press: London, England, 1961.
5. Ahluwalia V K, Dhingra, S., College Practical Chemistry, UniversityPress, Hydrabad, 2015.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Identify cations and simple anions in a mixture of salts
CO2: Determine the quality of interfering anions using semi-micro scheme of analysis
CO3: Develop industrial based skills.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO1/PSO3

SEMESTER - V

BCHC 0011: PHYSICAL CHEMISTRY – IV

Objective: This course aims to develop understanding and conceptual basis of Quantum Mechanics, Surface Chemistry and Catalysis.

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

Module No.	Content	Teaching Hours (Approx.)
I	**Quantum Mechanics-I:** Electron and the Old Quantum Theory, Quantum theory of radiation Photoelectric effect, Comparison between Classical & Quantum mechanics (or wave mechanics), Postulates of quantum mechanics, The Schrödinger wave equation, Operators in quantum mechanics, Solution of the Schrödinger wave equation for some simple systems, Particle in a one–dimensional box, one–dimensional simple harmonic oscillator, Rigid rotor, The Schrödinger equation for hydrogen atom, Angular momentum in quantum mechanics **Catalysis:** Characteristics of catalytic reactions, Acid–base catalysis Enzyme catalysis Mechanism and kinetics of enzyme– catalysed reactions The Michaelis–Menten equation Effect of temperature on enzyme catalysis	24
II	**Surface Chemistry** Adsorption by solids, Chemisorption, Applications of adsorption: Adsorption of gases by solids, Factors influencing adsorption. The Freundlich adsorption isotherm, The Langmuir theory of adsorption The BET theory of multilayer adsorption, Derivation of the BET equation, Types of adsorption isotherms, Adsorption from solution The Gibbs adsorption isotherm, Insoluble surface films on liquids. Modern techniques for investigating surfaces (Basic idea only): LEED, PES,and STM. **The Nernst Distribution Law:**Nernst Distribution law, Thermodynamic derivation Association of the solute in one of the solvents, Dissociation of the solute in one of the solvents, Solute enters into chemical combination with, one of the solvents	24

Reference Books:

1. Hofmann, A. Physical Chemistry Essentials, 1st ed.; Springer International Publishing: Basel, Switzerland, 2018.
2. Lones, L. Essentials of Physical Chemistry; Createspace Independent Publishing Platform: North Charleston, SC, 2017.
3. Shillady, D. Essentials of Physical Chemistry; CRC Press: Boca Raton, FL, 2011.
4. Essentials of Physical Chemistry; Miller, F., Ed.; NY Research Press, 2017.
5. Bahl, B. S.; Tuli, G. D.; Bahl, A. Essentials of Physical Chemistry, 24th ed.; S Chand: New Delhi, India, 2000.

Text Book

1. Woldeamanuel, M. M. Text Book of Physical Chemistry for Science and Engineering Students; LAP Lambert Academic Publishing, 2019.
2. Waldeck, D. H.; Kuhn, H.; Forsterling, H.-D. Principles of Physical Chemistry; John Wiley & Sons: Nashville, TN, 2013.
3. Raff, L. M. Principles of Physical Chemistry; Pearson: Upper Saddle River, NJ, 2001.
4. Atkins, P. W.; Clugston, M. J. Principles of Physical Chemistry; Pitman Publishing: Harlow, England, 1982.

(1) Coller, B. A. W.; etc. Principles of Physical Chemistry; Hodder Arnold: London, England, 1978.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Compare Classical & Quantum mechanics
CO2: Establish Schrodinger wave equation forparticle in a 1D box, simple harmonic oscillator, Rigid rotor and angular momentum in quantum mechanics
CO3: Derive the expression for Schrödinger wave equation, Freundlich adsorption isotherm, and BET equation.
CO4: Understand the BET theory of multilayer adsorption, Langmuir theory of adsorption Effect of temperature on enzyme catalysis.
CO5: Identify the types of adsorption isotherms, Mechanism and kinetics of enzyme– catalysed reactions.
CO6: Deduce Nernst Distribution Law and Michaelis–Menten equation
CO7: Develop competitive skills.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3, PO6/PSO5

BCHC 1015: PERICYCLIC AND PHOTOCHEMISTRY

Objective: This course aims to develop deeper understanding of pericyclic, and photochemical reactions.

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

Module No.	Content	Teaching Hours (Approx.)
I	**Pericyclic Chemistry:** Classification and stereochemistry of pericyclic reactions: Woodward Hoffmann correlation diagrams. FMO and PMO approach, **Electrocyclic Reactions**, **cycloaddition:** Cycloaddition, antarafacial, suprafacial additions, 4n and 4n+2 systems. 2+2 addition of Ketenes, 1,3-dipolar cycloadditions &cheletropic reactions, Sigmatropic Reactions, Ene reactions, Important problems related to competitive examinations	24
II	**Photochemistry:** Introduction General Principles, photochemistry of Alkenes, Dienes, and Polyenes, cis-trans Isomerization, Photoreactions of Other Alkenes. Photoisomerization of 1,3-Butadiene, Orbital Symmetry Considerations for Photochemical, Reactions of Alkenes and Dienes, Photochemical Electrocyclic Reactions Photochemical Cycloaddition Reactions, Photochemical Rearrangements Reactions of 1,4-Dienes, Photochemistry of Carbonyl Compounds, Hydrogen Abstraction and Fragmentation Reactions, Cycloaddition and Rearrangement Reactions of Cyclic, Unsaturated Ketones, Cycloaddition of Carbonyl Compounds and Alkenes, Photochemistry of Aromatic Compounds, Interpretation of Diene, and Polyene Photochemistry. Photooxidation and Photoreduction, Photochermistry of Azo compounds, Barton reaction, Hoffmann LoefflerFretag reaction, Important problems related to competitive examinations	24

Text Books:

1. Singh, J. Photochemistry and Pericyclic Reactions; New Age Science: London, England, 2009.
2. Sharma, V. P.; Kumar, R. Pericyclic Reactions and Organic Photochemistry; PragatiPrakashan, 2008.
3. Dinda, B. Essentials of Pericyclic and Photochemical Reactions; Springer International Publishing: Cham, Switzerland, 2018.
4. Pericyclic Reactions; Marchand, A. P., Lehr, R. E., Eds.; Academic Press, 2013

Reference Books:

1. Fleming, I. Pericyclic Reactions, 2nd ed.; Oxford University Press: London, England, 2015.
2. Kumar; Singh. Pericyclic Reactions: A Mechanistic and Problem-Solving Approach; Academic Press: San Diego, CA, 2015.
3. Photochemistry: Volume 29; Gilbert, A., Ed.; Gilbert, A., Series Ed.; Royal Society of Chemistry: Cambridge, England, 2001.
4. Guillet, J. Polymer Photophysics Photochemistry; Cambridge University Press: Cambridge, England, 1985.

5. Barltrop, J. A.; Coyle, J. D. Principles of Photochemistry; John Wiley & Sons: Chichester, England, 1978.
6. Margaretha, P. Preparative Organic Photochemistry; Lehn, J.-M., Ed.; Springer: Berlin, Germany, 2013.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the basic principle of pericyclic and photochemistry.
CO2: Classify the pericyclic and photochemical reactions
CO3: Draw Woodward Hoffmann correlation diagrams for concerted reactions
CO4: Propose Mechanism for pericyclic and photochemical reactions.
CO5: Identify the type of electrocyclic reactions
CO6: Predict the name of a reaction and its mechanistic routes for pericyclic and photochemical reactions
CO7: Develop competency for different national level examinations

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

COs	**POs/PSOs**
CO1	PO1/PSO2
CO2	PO5, PO8/PSO3
CO3	PO2, PO3/PSO4
CO4	PO5,PO7/PSO5
CO5	PO4, PO10, PO1/PSO1
CO6	PO9,PO3/PSO3
CO7	PO2, PO3/PSO4

BCHC 0013: INORGANIC CHEMISTRY - III

Objective: To develop basic and fundamental concepts of Organo-metallic Compounds, Metal carbonyls, Inorganic Polymers and group theory.

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

Module No.	Content	Teaching Hours (Approx.)
I	**Organo-metallic Compounds:** Definition and classification of organometallic compounds, EAN rule, Organometallics in homogeneous catalysis **Metal carbonyls:** Preparation, properties, structure and bonding of mononuclear carbonyls. Π acceptor behavior of carbon monoxide, synergic effect (MO diagram of CO, NO) Carbonylate anions, ferrocene and its reactions. **Cages and metal clusters.**	24
II	**Noble Gases:** Occurrence & uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF2 and XeF4, XeF6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2). Molecular shapes of noble gas compounds (VSEPR theory). **Inorganic Polymers:** Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates **Group Theory:** Definition of group, symmetry, point groups, representation of group, orthogonality theorem, irreducible representation, character table	24

Reference Books:

1. Lee, J. D. Concise Inorganic Chemistry, 4th ed.; Chapman and Hall: London, England, 1991.
2. Chandra, S. Concise Inorganic Chemistry; I K International Publishing House: New Delhi, India, 2011.
3. Thakur, O. P. CONCISE INORGANIC CHEMISTRY; Amiga Press: Delhi, India, 2018.
4. Lowrie, R. S. Concise Notes in Inorganic Chemistry; Pergamon Press: London, England, 1965.
5. Ganguly, A. Fundamentals of Inorganic Chemistry; Pearson, 2010.

Text Books:

1. Cotton, F. A.; Wilkinson, G.; Murillo, C. A.; Bochmann, M. Advanced Inorganic Chemistry, 6th ed.; John Wiley & Sons: Nashville, TN, 1999.
2. Durrant, P. J.; Durrant, B. Introduction to Advanced Inorganic Chemistry, 2nd ed.; Prentice Hall Press: London, England, 1972.
3. Rastogi, A. Advanced Inorganic Chemistry; Anmol Publications: New Delhi, India, 2010.
4. Choudhary, N. L. Fundamentals of Inorganic Chemistry; Shree Publishers & Distributors: New Delhi, India, 2020.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Draw the structure of metal carbonyls, compounds of noble gases, Borazines, silicates and phosphazenes, and polysulphates etc.
CO2: Differentiate metallic and organometallic compounds
CO3: Understand the chemistry of interaction between various metals and ligands.
CO4: Synthesize various organometallic compounds, Borazines, silicates and phosphazenes, and polysulphates etc.
CO5: Predict the spectral and magnetic properties of compounds of noble gases
CO6: Identify symmetry, point groups, representation of group, orthogonality theorem, irreducible representation, character table
CO7: Develop competency for different national level examinations.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO2, PO9/PSO4

BCHC 0909: CHEMISTRY LAB IX

Objective: To provide practical exposure to the experiments of thermochemistry.

Credits: 02 **Semester V** **L–T–P : 0–0–4**

1. Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
2. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Calculation of the enthalpy of ionization of ethanoic acid.
4. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
5. Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
6. Determination of enthalpy of hydration of copper sulphate.
7. Study of the solubility of benzoic acid in water and determination of ΔH.

NOTE: All the safety measures or steps for all the respective experiments must be taken care of strictly.

Reference text:

1. James, A. M.; Prichard, F. E. Practical Physical Chemistry, 3rd ed.; Prentice Hall Press: London, England, 1974.
2. Firth, J. B. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
3. Findlay, A. Practical Physical Chemistry; Franklin Classics Trade Press, 2018.
4. Viswanathan, B. Practical Physical Chemistry; Viva Books: New Delhi, India, 2012.
5. Maity, S. K.; Ghosh, N. K. Physical Chemistry Practical; New Central Book Agency: Delhi, India, 2012.
6. Viswanathan, B.; Raghavan, P. S. Practical Physical Chemistry; Viva Books: New Delhi, India, 2014.
7. Gray, F. W. A Manual of Practical Physical Chemistry; Rarebooksclub.com, 2012.
8. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
9. Ahluwalia V K, Dhingra, S., College Practical Chemistry, UniversityPress, Hydrabad, 2015.
10. B. Viswanathan, P. S. Raghavan, Practical Physical Chemistry, Viva Books Private Limited, 2010.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Determine the heat capacity, enthalpy of neutralization, integral enthalpy and enthalpy of hydration
CO2: Calculate the enthalpy of ionization of ethanoic acid
CO3: Find out solubility of benzoic acid in water
CO4: Estimate the basicity/proticity of a polyprotic acid by the thermochemical method
CO5: Develop competency as well skill based on industrial synthesis.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO6/PSO4
CO3	PO3, PO4/PSO5
CO4	PO3,PO8/PSO1
CO5	PO1/PSO3

BCHC0910: CHEMISTRY LAB - X

Objective: To provide practical exposure and hand on expertise to the experiments of organic Chemistry

Credits: 02 **Semester V** **L–T–P : 0–0–4**

I. Tests for functional groups

II. Qualitative analysis of following types of unknown organic compounds
1. Carbohydrates
2. Primary, secondary and tertiary amines
3. Nitro compounds
4. Amides
5. Aryl halides
6. Hydrocarbons

III. Identification of the functional groups, C-C and C-N triple bonds, sp^3, sp^2 and sp hybridized C-H bonds by IR spectroscopy (IR spectra to be provided)

IV. ***Estimation of:***
1. Phenol and aniline by bromination with potassium bromate-potassium bromide method
2. Glycine by formylation method
3. Saponification value of an oil/fat

NOTE: All the safety measures or steps for all the respective experiments must be taken care of strictly.

Reference text:

Reference/text books:

1. Ahluwalia, V. K.; Aggarwal, R.; Alluwalia, V. K. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis; Sangam Books: London, England, 2001.
2. Practical Organic Chemistry: A Student Handbook of Techniques, 1989th ed.; Sharp, J. T., Ed.; Springer: Dordrecht, Netherlands, 1989.
3. Ahluwalia, V. K.; Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis; Sangam Books: London, England, 2001.
4. Procter, G.; Leonard, J.; Casey, M.; Lygo, B. Advance Practical Organic Chemistry, 1990th ed.; Nelson Thornes: Cheltenham, England, 1989.
5. Practical Synthetic Organic Chemistry: Reactions, Principles, and Techniques, 1st ed.; Caron, S., Ed.; John Wiley & Sons: Nashville, TN, 2011.
6. Vogel, A. I. Textbook of Practical Organic Chemistry, 4th ed.; Longman: London, England, 1978.
7. Leonard, J.; Lygo, B.; Procter, G. Advanced Practical Organic Chemistry, 3rd ed.; CRC Press: Boca Raton, FL, 2013.
8. Vogel, A. I. Elementary Practical Organic Chemistry: Preparations Pt. 2, 3rd ed.; Smith, B. V., Waldron, N. M., Series Eds.; Prentice Hall Press: London, England, 1980.
9. Vogel, A. I.; Tatchell, A. R.; Furnis, B. S.; Hannaford, A. J.; Greig- Smith, P. W. Vogel's Textbook of Practical Organic Chemistry, 5th ed.; Prentice-Hall: London, England, 1989.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Detect extra elements in given unknown compounds

CO2: Testify functional groups in unknown compounds
CO3: Analyze unknown organic compounds like Carbohydrates, Primary, secondary and tertiary amines, Nitro compounds, Amides, Aryl halides and Hydrocarbons
CO4: Identify of the functional groups, C-C and C-N triple bonds, sp^3, sp^2 and sp hybridized C-H bonds by IR spectroscopy
CO5: Develop competency and industrial operations based synthesis skills.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO2, PO9/PSO4

BCHC 0911: CHEMISTRY LAB XI

(Inorganic 3)

Objective: To provide practical exposure and hand on expertise to the experiments of inorganic Chemistry

Credits: 02 **Semester V** **L–T–P : 0–0–4**

(a) Quantitative Analysis:

The following quantitative estimations are to be carried out.

i. Estimation of nickel (II) using Dimethylglyoxime as the precipitant.

ii. Estimation of copper as CuSCN

iii. Estimation of iron as Fe2O3 by precipitating iron as $Fe(OH)_3$ through (i)

iv. Heterogeneous and (ii) Homogeneous media

v. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminiumoxinate).

(b) Inorganic Preparations:

(i) Tetraammine copper (II) sulphate, $[Cu(NH_3)_4]SO_4\ H_2O$

(ii) Potassium trisoxalatochromate (III), $K_3[Cr(C_2O_4)_3]$

iii. Cis and trans $K[Cr(C_2O_4)_2\ (H_2O_2]$ Potassium dioxalatodiaquachromate

iv. Pentaamminecarbonato Cobalt (III) ion

(a) Spectrophotometric estimation of Ferrous ions by using 1,10 phenanthroline

NOTE: All the safety measures or steps for all the respective experiments must be taken care of strictly

Reference/text books:

1. Jago, W. Inorganic Chemistry, Theoretical and Practical, an Elementary Text-Book; Rarebooksclub.com, 2012.
2. Turpin, G. S. Practical Inorganic Chemistry; General Books, 2009.
3. Vogel, A. I. Textbook of Quantitative Inorganic Analysis, 4th ed.; Longman: London, England, 1978.
4. Vogel, A. I. Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rd ed.; Prentice Hall Press: London, England, 1961.
5. Ahluwalia V K, Dhingra, S., College Practical Chemistry, UniversityPress, Hydrabad, 2015.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Analyze Ferrous ions by spectrophotometry

CO2: Determine of the melting points using Kjeldahl method and boiling point of liquid compounds by distillation and capillary method

CO3: Differentiate Heterogeneous and (ii) Homogeneous media

CO4: Estimate nickel (II), copper, iron, Al (III), $^{+}$ in a given sample.

CO5: Develop competency and skills based on industries.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO2, PO9/PSO4

SEMESTER - VI

BCHC 1014: PHYSICAL SPECTROSCOPIC TECHNIQUES

Objective: To develop basic and fundamental concepts of various molecular spectroscopic techniques and their application.

Credits: 04 **Semester VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Molecular Spectroscopy-I:** Introduction to molecular spectroscopy, Basic features of spectrometers, Width and intensity of spectral lines, Molecular spectra **Rotational (microwave) spectroscopy:** Rotational (microwave) spectra of diatomic, molecules, Relative intensities of rotational spectral lines, Applications of Microwave spectroscopy, Rotational spectra of polyatomic molecules, Stark effect in microwave spectra, Other applications of microwave spectra **Vibrational spectroscopy:** Vibrational spectra of diatomic molecules, Rotation–vibration spectra of diatomic molecules, Vibrational spectra of polyatomic molecules, Rotation-vibration spectra of polyatomic molecules, Vibrational frequencies of different functional groups	24
II	**Raman spectroscopy:** What is scattering, elastic and non-elastic scattering, basics of Raman Spectroscopy **Molecular Spectroscopy-II** **NRF Spectroscopy** Mössbauer spectroscopy: Basic principle of NRF Mössbauer experiment, Chemical isomer shift, Nuclear quadrupole splitting, Nuclear Zeeman splitting. **Photoelectron spectroscopy (PES):** Basic principle and its applications	24

Reference Books:

(1) Physical Chemistry - Series Two: Spectroscopy v. 3; Ramsey, D. A., Series Ed.; Butterworth-Heinemann: Woburn, MA, 1976.
(2) Weissberger, A. Physical Methods of Chemistry: Spectroscopy and Spectrometry in the Infrared Visable and Ultraviolet Pt. 3B; Weissberger, A., Rossiter, B. W., Eds.; John Wiley & Sons: Nashville, TN, 1972.
(3) Mueller, M. Fundamentals of Quantum Chemistry. Molecular Spectroscopy and Modern Electronic Structure Computations; Springer: New York, NY, 2001.
(4) Mueller, M. P. Fundamentals of Quantum Chemistry: Molecular Spectroscopy and Modern Electronic Structure Computations, 2001st ed.; Springer: New York, NY, 2013.

Text Book:

(1) Darris, M. S. A Brief Study of Physical Spectroscopy; LAP Lambert Academic Publishing, 2020.
(2) Banwell, C. N.; McCash, E. M. Fundamentals for Molecular Spectroscopy, 4th ed.; McGraw-Hill Professional: New York, NY, 1994.
(3) Struve, W. S. Fundamentals of Molecular Spectroscopy; John Wiley & Sons: Nashville, TN, 1989.
(4) Sindhu, P. S. Fundamentals of Molecular Spectroscopy; New Age International: New Delhi, India, 2011.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the theory and principle of molecular spectroscopy including Rotational (microwave) spectroscopy, Vibrational spectroscopy, Raman spectroscopy, NRF Spectroscopy and Photoelectron spectroscopy.
CO2: Apply Stark effect in determination of symmetry of a molecule
CO3: Elucidate the structure of organic compounds.
CO4: Calculate the relative intensities of rotational spectral lines
CO5: Interpret the Rotational spectra, rotation–vibration spectra of homo and diatomic molecules, Raman spectra, NRF and PES Spectra
CO6: Predict the no. of lines in NRF Spectra, no. of vibration in Raman Spectra.
CO7: Differentiate two closely related compounds on the basis of molecular spectroscopy.
CO8: Develop competitive skills for different competitive examinations.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3, PO6/PSO5
CO8	PO3, PO6/PSO5

BCHC 0012: ORGANIC CHEMISTRY – IV

Objective: This course introduces students to carbohydrates, lipids, nucleic acids, and amino acids. Students will be familiarized with the importance of carbohydrates, lipids, nucleic acids, and amino acids.

Credits: 04 **Semester VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Carbohydrates** Occurrence, classification and their biological importance Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose, lactose and sucrose Polysaccharides – Elementary treatment of starch, cellulose and glycogen. **Nucleic Acids** Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil nd Thymine; Structure of polynucleotides. **Lipids:** Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats, and oils, Saponification value, acid value, iodine number. Reversion and rancidity.	24
II	**Amino acids, Peptides and Proteins** Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups - Solid-phase synthesis **Alkaloids** Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine. **Terpenes;** Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral and α- terpineol.	24

Reference Books:

1. Miller, B. *Advanced Organic Chemistry: International Edition*, 2nd ed.; Pearson: Upper Saddle River, NJ, 2004.
2. Bruckner, R. *Advanced Organic Chemistry: Reaction Mechanisms*; Academic Press: San Diego, CA, 2001.
3. Lewis, D. E. *Advanced Organic Chemistry*; Oxford University Press: New York, NY, 2015.

4. March, J. *Advanced Organic Chemistry*, 4th ed.; John Wiley & Sons: Nashville, TN, 1992.

Text Books:

1. Pandit, V. *Advanced Level Organic Chemistry: Questions and Answers*; Vijay Pandit: London, England, 1980.
2. Carey, F. A. *Advanced Organic Chemistry: Part B: Reactions and Synthesis*, 1983rd ed.; Springer: New York, NY, 2013. https://doi.org/10.1007/978-1-4757-1821-8.
3. Mundy, B. P. *Advanced Organic Chemistry*; John Wiley & Sons: Chichester, England, 2010.
4. Sharma, R. R. G. *Advanced Organic Chemistry*; Pacific Books International, 2012.
5. Singh, A.; Singh, R. Textbook of Organic Chemistry; Campus Books International: New Delhi, India, 2005.
6. Tewari, K. S.; etc. A Textbook of Organic Chemistry, 2nd ed.; Sangam Books: London, England, 1999.
7. A Textbook on Organic Chemistry; New Central Book Agency: Delhi, India, 2010.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Draw the structure of Carbohydrates, Nucleic Acids, Amino acids, Peptides and Proteins, Lipids, Alkaloids and Terpenes.
CO2: Determine the ring size of glucose and fructose.
CO3: Interconvert aldoses and ketoses
CO4: Elucidate the structure of Carbohydrates, Nucleic Acids, Amino acids, Peptides and Proteins, Lipids, Alkaloids and Terpenes.
CO5: Design and propose mechanism for synthetic routes for natural products.
CO6: Identify the medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.
CO7: Develop competitive skills.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO2, PO9/PSO4

BCHC 0912: CHEMISTRY LAB - XII

Objective: To prove the exposure of hand on expertise on experiments related to analytical techniques.

Credits: 02 **Semester VI** **L–T–P : 0–0–4**

Colorimetric Analysis

1. Verification of Lambert-Beer's Law
2. Determination of pK (indicator) for phenolphthalein or methyl red
3. Study the formation of a complex between ferric and thiocyanate (or salicylate) ions.
4. Study the kinetics of interaction of crystal violet with sodium hydroxide colourimetrically.
5. Analysis of the given vibration-rotation spectrum of HCl(g)
6. Record the UV spectrum of p-nitrophenol (in 1:4 ethanol:water mixture). Repeat after adding a small crystal of NaOH. Comment on the difference, if any.
7. Record the U.V. spectrum of a given compound (acetone) in cyclohexane
   (a) Plot transmittance *versus* wavelength. (b) Plot absorbance *versus* wavelength.
   (c) Calculate the energy involved in the electronic transition in different units, i.e. cm^{-1}, kJ/mol, kcal/mol& eV.

Separation Techniques

1. Solvent Extractions:
   (i) To separate a mixture of Ni^{2+}& Fe^{3+} by complexing with DMG and extracting the Ni^{2+} DMG complex in chloroform, and determine its concentration with spectrophotometry.
   (ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.
2. Determine the pH of given aerated drinks fruit juices, shampoos and soaps.
3. Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.
4. Analysis of soil:
   (i) Determination of pH and electrical conductivity of soil. (ii) Total soluble salt
   (iii) Estimation of calcium, magnesium, phosphate, nitrate
5. Determination of chemical oxygen demand (COD).
6. Determination of Biological oxygen demand (BO)
7. Determination of ascorbic acid in lemon juice.
8. Determination of adulterants in milk

Reference/text books:

1. Maity, S. K.; Ghosh, N. K. Physical Chemistry Practical; New Central Book Agency: Delhi, India, 2012.
2. Viswanathan, B.; Raghavan, P. S. Practical Physical Chemistry; Viva Books: New Delhi, India, 2014.
3. Gray, F. W. A Manual of Practical Physical Chemistry; Rarebooksclub.com, 2012.
4. Ahluwalia, V. K.; Aggarwal, R.; Alluwalia, V. K. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis; Sangam Books: London, England, 2001.
5. Mann, F. G.; Saunders, B. C. Practical Organic Chemistry; Longman: London, England, 1979.
6. Practical Organic Chemistry: A Student Handbook of Techniques, 1989th ed.; Sharp, J. T., Ed.; Springer: Dordrecht, Netherlands, 1989.

7. Ahluwalia, V. K.; Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis; Sangam Books: London, England, 2001.
8. Vogel, A. I. Textbook of Practical Organic Chemistry, 4th ed.; Longman: London, England, 1978.
9. Leonard, J.; Lygo, B.; Procter, G. Advanced Practical Organic Chemistry, 3rd ed.; CRC Press: Boca Raton, FL, 2013.
10. Vogel, A. I. Elementary Practical Organic Chemistry: Preparations Pt. 2, 3rd ed.; Smith, B. V., Waldron, N. M., Series Eds.; Prentice Hall Press: London, England, 1980.
11. Vogel, A. I.; Tatchell, A. R.; Furnis, B. S.; Hannaford, A. J.; Greig- Smith, P. W. Vogel's Textbook of Practical Organic Chemistry, 5th ed.; Prentice-Hall: London, England, 1989

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Verify Lambert-Beer's Law

CO2: Determine pK (of indicators), pH (of given aerated drinks fruit juices, shampoos and soaps), Na, Ca, Li (in cola drinks and fruit juices), ascorbic acid (in lemon juice) and adulterants (in milk).

CO3: Analyze given vibration-rotation spectrum of HClspectrophotometrically

CO4: Separate a mixture of Ni^{2+}& Fe^{3+} by complexing with DMG

CO5: Extract the Ni^{2+} DMG complex in chloroform.

CO6: Develop Competency and industry based skills.

NOTE: All the safety measures or steps for all the respective experiments must be taken care of strictly.

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

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO9, PO7/PSO1
CO3	PO3, PO1/PSO2
CO4	PO7, PO11/PSO3
CO5	PO2, PO2, PO8/PSO6
CO6	PO3, PO1/PSO2

BCHE 0951: PROJECT

Objective: To develop the analytical and research skills through minor projects.

Credits: 04 **Semester VI** **L–T–P : 0–0–8**

Description:

- Each student will do project work under the guidance of supervisor from the department of chemistry and has to submit the report after completion of the project.
- Students may be asked to write a review/ research article on the theme of project.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:
CO1: Develop analytical and research skills
CO2: Write a review/ research article
CO3: Develop habit of working independently in laboratory
CO4: Develop research skills and competency.

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

COs	POs/PSOs
CO1	PO2/PSO1
CO2	PO5, PO3/PSO2
CO3	PO4, PO3/PSO5
CO4	PO2/PSO1

DISCIPLINE SPECIFIC ELECTIVES

BCHE 1001: FUNDAMENTALS OF CHEMICAL ANALYSIS

Objective: To provide the basis of theory, principle and applications of analytical techniques being used in chemical science.

Credits: 04 **Semester III/IV/V/VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Theory of Volumetric and Gravimetric Analysis** Introduction, Titrimetric analysis, classifications of reactions in titrimetric analysis, standard solutions, preparation of standard solutions, primary and secondary standards, Indicators, theory of indicators, Acid–base titrations in non-aqueous media, Redox titrations **Gravimetric Analysis**: Impurities in precipitates, Gravimetric calculations, precipitation equilibria (Solubility product, common ion effect, stoichiometry), organic precipitation **Distillation:** Basic principle, types (continuous, batch, vacuum, steam, and fractional distillation) and applications.	24
II	**Complexometric equilibria** Introduction, Titration curves, Types of EDTA titrations, Methods of End Point Detection: a)Indicators (b) Instrumental methods of End point detection (Spectrophotometric, Amperometric, Potentiometric, High frequency titrator), Types of Complexometric Titrations (a) Direct Titration (b) Back Titration (c) Replacement titration (d) Indirect Titration (e) Applications of Complexometric Titrations **Solvent extraction techniques:** Basic principles, different types of extraction, selection of solvents avoiding emulsion formation.	24

Reference Books:

1. R. L. Pecsok, L. D. Shields, T. Cairns and L.C. McWilliam, Modern Methods of Chemical Analysis, (1976), John Wiley & Sons, New York.
2. D. A. Skoog, Principles of Instrumental Analysis, 5th Edition (1998), Saunders College of Publishing, Philadelphia, London.
3. H. A. Strobel, Chemical Instrumentation: A Schematic Approach, 2nd Edition (1973), Addison Wesley, Reading, Mass.

Text Books

1. D. A. Skoog and D. M. West, Fundamental of Analytical Chemistry, 7th Edition (1996), Saunders College Publishing, Philadelphia, Holt, London.
2. Analytical chemistry, G. D. Christian, Sixth Edition, Wiley publications

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand theory and principles of volumetric, gravimetric and complexometric analysis
CO2: Prepare the standard and working solutions for different analysis.

CO3: Analyze the data of volumetric and gravimetric**,** complexometric titrations
CO4: Draw the titration curves obtained from different analytical procedures
CO5: Apply the principle of distillation in analytical methods
CO6: Extract the solvent using Solvent extraction techniques for the synthesis of organic and inorganic compounds.
CO7: Develop Competency for different examinations.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3, PO6/PSO5

BCHE 1002: ORGANIC SPECTROSCOPIC TECHNIQUES

Objective: To provide fundamental principles and applications of various spectroscopic techniques like UV-VIS, IR, NMR and MS.

Credits: 04 **Semester IV** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Spectroscopy Introduction:** Electromagnetic radiation, regions of spectrum, Basic features of spectroscopy. **UV-Vis spectroscopy** Introduction, Principle & theory of UV-Vis spectroscopy, Instrumentation of UV-Visible Spectro-photometer. Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation, Solvent effect. Concept of chromophore and auxochrome. Woodward-Fieser rules, calculation of λmax of simple conjugated dienes and α,β-unsaturated ketones. Applications of UV Spectroscopy in structure elucidation of simple organic compounds. **Infrared (IR) spectroscopy:** Principle, theory and Instrumentation of FT-IR spectrophotometer. Molecular vibrations, Hooke's law, Degrees of freedom. **NMR Spectroscopy:** Principle of nuclear magnetic resonance, Interpretation of the NMR spectrum (number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift, shielding and deshielding of protons, proton counting, splitting of signals and coupling constants, magnetic equivalence of protons). Discussion of PMR spectra of simple and complex organic molecules Simple problems on PMR spectroscopy for structure determination of organic compounds. ^{13}C NMR Spectroscopy applications. Nuclear Overhauser Experiment.	20
II	**Mass Spectrometry** Introduction – basic theory, instrumentation, process of introducing the sample into mass spectrometer. Methods of generation of positively charged ions, electron ionization method, chemical ionization, FD and fast atom bombardment (FAB) techniques. Mass spectrum, base peak, molecular and parent ion, Mass to charge ratio (M/Z), relative intensity, fragment ions, even electron rule, nitrogen rule, metastable ions, McLafferty rearrangement and ortho effect. Application in structure Elucidation of Organic compounds, Determination of molecular weight and molecular formula using mass spectrometry	18

Reference Books:

1. Yadav, L. D. S. Organic Spectroscopy, 2004th ed.; Springer: New York, NY, 2013.
2. Kemp, W. Organic Spectroscopy, 3rd ed.; Red Globe Press: London, England, 1991.
3. Pavia, D. L.; Lampman, G. M.; Kriz, G. S. Introduction to Spectroscopy, 3rd ed.; Brooks/Cole: Florence, KY, 2000.

Text Books:

1. Brown, D. W.; Floyd, A. J.; Sainsbury, M. Organic Spectroscopy; John Wiley & Sons: Chichester, England, 1988.

2. Ionin, B. I. NMR Spectroscopy in Organic Chemistry, 1970th ed.; Springer: New York, NY, 2013.
3. Lambert, J. B.; Shurvell, H. F.; Lightner, D.; Cooks, R. G. Organic Structural Spectroscopy; Pearson: Upper Saddle River, NJ, 1997.
4. Williams, D. H.; Fleming, I. Spectroscopic Methods in Organic Chemistry, 4th ed.; McGraw-Hill Publishing: London, England, 1989.
5. Introduction to Experimental Infrared Spectroscopy: Fundamentals and Practical Methods; Tasumi, M., Ed.; Wiley-Blackwell: Hoboken, NJ, 2014.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the theory and principle of various spectroscopic techniques such as UV-VIS, IR, NMR and MS.
CO2: Apply Woodward-Fieser rules to calculate of □max of organic compounds.
CO3: Elucidate the structure of organic compounds Interpret the spectra obtained in various spectroscopic techniques such as UV-VIS, IR, NMR and MS.
CO4: Predict the no. of signals in NMR Spectra, no. of vibration in IR Spectra, molecular ion and other fragmented ions in MS spectra.
CO5: Determine molecular weight and molecular formula using mass spectrometry
CO6: Develop competitive skills.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO1/PSO3

BCHE 0005: FUEL CELL TECHNOLOGY

Objective: This course aims to develop general knowledge including some advanced concepts of fuel cell technology.

Credits: 04 **Semester IV** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	Overview of fuel cells: Basic Chemistry of Fuel Cells, Low and high temperature fuel cells, anode and cathode reactions , Oxidation reduction reaction, Hydrogen oxidation, Methanol oxidation, Methanol tolerance and its importance. Fuel cell thermodynamics - heat, work potentials, prediction of reversible voltage, fuel cell efficiency. Two and four electron process. and mechanism	24
II	Fuel cell reaction kinetics - electrode kinetics, overvoltages, Tafel equation, charge transfer reaction, exchange currents, electrocatalysis - design, activation kinetics, Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte. Rotating disk electrocatalysis, rotating ring electrode disk electrocatalysis and their chemistry. Balance of plant; Hydrogen production from renewable sources and storage; safety issues, cost expectation and life cycle analysis of fuel cells. Recent advances and challenges in fuel cell research and a directional material designs.	24

Reference Books/

1. Dicks, A. L.; Rand, D. A. J. Fuel Cell Systems Explained, 3rd ed.; John Wiley & Sons: Nashville, TN, 2018.
2. Barclay, F. J. Fuel Cells, Engines and Hydrogen: An Exergy Approach, 1st ed.; John Wiley & Sons: Chichester, England, 2006.
3. Li, X. Principles of Fuel Cells; CRC Press: Boca Raton, FL, 2006.
4. Hoogers, G. Fuel Cell Technology Handbook, 2nd ed.; CRC Press: Boca Raton, FL, 2011.

Text Books:

1. Concise Inorganic Chemistry. J.D. Lee. ELBS. John Wiley.
2. Fuel Cell Fundamentals, R. O'Hayre, S-W. Cha, W. Colella, F. B. Prinz (John Wiley and Sons, 2005, USA)
3. Fuel Cells: Principles and Applications, B. Viswanathan and M. A. Scibioh (Universities Press, 2006, India)
4. Fuel Cells: From Fundamental to Applications, S. Srinivasan (Springer, 2006, USA)

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the theory and principle of fuel cells.
CO2: Design the mechanism for electrode reactions in fuel cells.
CO3: Predict fuel cell efficiency, heat energy, Gibbs free energy of fuel cells.
CO4: Draw the core structure of hydrogen plant as a renewable source of energy.
CO5: Design and develop the electrode material for fuel cells.
CO6: Investigate the kinetics of electrode reactions in fuel cells
CO7: Develop Competitive skills for various competitive examinations.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO2, PO9/PSO4

BCHE 1003: CHROMATOGRAPHIC TECHNIQUES

Objective: To provide conceptual aspects of various chromatographic techniques and their applications.

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

Module No.	Content	Teaching Hours (Approx.)
I	**Introduction to Chromatographic methods** Principles of analytical separation: Plate theory, Craig concept of counter current distribution, process optimization, Retention analysis; Resolution (Fundamental equation). **Conventional methods of Chromatography** (Thin layer, Paper, Size Exclusion) **Gas Chromatography** Introduction, instrumentation, types of column (packed, open tubular etc.), types of detector (TCD, ID, FID, ECD, and element selective detectors), programme temperature gas chromatography, applications of GC for quantitative analysis. Internal standard method and standard addition method.	24
II	**High performance liquid chromatography** Introduction, Types of liquid chromatography, high performance liquid chromatography and instrumentation, derivatization, quantitative analysis, thin layer chromatography, high performance thin layer chromatography, **Ion chromatography:** Basic principles, separator column, suppressor columns, detectors, applications. **Ion exchange chromatography:** Introduction, ion exchange equilibria, types of ion exchange resins (strongly acidic, strongly basic, weakly acidic, weakly basic), instrumentation, and ion exchange capacity.	24

Reference Books:

1. R. L. Pecsok, L. D. Shields, T. Cairns and L.C. McWilliam, Modern Methods of Chemical Analysis, (1976), John Wiley & Sons, New York.
2. D. A. Skoog, Principles of Instrumental Analysis, 5th Edition (1998), Saunders College of Publishing, Philadelphia, London.
3. H. A. Strobel, Chemical Instrumentation: A Schematic Approach, 2nd Edition (1973), Addison Wesley, Reading, Mass.

Text Books:

1. D. A. Skoog and D. M. West, Fundamental of Analytical Chemistry, 7th Edition (1996), Saunders College Publishing, Philadelphia, Holt, London.
2. Analytical chemistry, G. D. Christian, Sixth Edition, Wiley publications

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the theory and principles of GC, HPLC, TLC, ion exchange chromatography
CO2: Determine the constituent's elements simultaneously in a mixture of inorganic salts.
CO3: Analyze constituents of a sample of mixture
CO4: Apply various chromatographic techniques for the separation of organic and inorganic compounds.
CO5: Check the purity of a sample mixture and active pharmaceutical ingredients
CO6: Extract the mixture of compounds from the given samples.
CO7: Develop Competitive skills.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO4,PO8/PSO1

BCHE 1004: ELECTROANALYTICAL AND RADIOANALYTICAL TECHNIQUES

Objective: To develop basic and fundamental aspects of various Electroanalytical and Radio-analytical techniques and their application.

Credits: 04 **Semester VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Ultra Purity and Ultra trace Analysis** Ultra purity and ultra-trace analysis, laboratory dosing, purification of reagents, Pre-concentration Techniques, Methods of trace analysis such as, XRF, AAS, DCP and ICP, High purity materials for electronic industry, contamination control during analytical operations. **Electroanalytical techniques:** Physicochemical background (such as the thermodynamics and kinetics of electron and ion transfer, the electric double layer, and mass transfer by diffusion and migration). Electrochemical methods in detail including ion-selective potentiometry, cyclic voltammetry, pulse voltammetry, ion-transfer voltammetry, and impedance spectroscopy. Instrumentation (rotating disk electrodes, microelectrodes. Stripping Voltammetry.	24
II	**Radio-analytical Chemistry** Separation methods, Precipitation, solvent extraction and chromatographic methods. Activation analysis (Nuclear Active Analysis), basic principles, fast neutron activation analysis, radiochemical methods in activation analysis, Applications in Geo-chemistry, oxygen in metals. Isotope dilution analysis: Principles and applications. Sub-stoichiometric determination of traces of metals: Principles, techniques and experimental methods in the determination of As, Pb and Hg.	24

Reference Books:

1. National Aeronaut Administration (Nasa). Analysis of Trace Halocarbon Contaminants in Ultra High Purity Helium; Createspace Independent Publishing Platform: North Charleston, SC, 2018.
2. Wang, J. Electroanalytical Techniques in Clinical Chemistry and Laboratory Medicine; John Wiley & Sons: Nashville, TN, 1988.
3. Zhou, Y. Classification and Nomenclature of Electroanalytical Techniques; Elsevier Science, 2013.
4. Handbook of Analytical Techniques; Gunzler, H., Williams, A., Eds.; Wiley-VCH Verlag: Weinheim, Germany, 2001.
5. Karger, B. L.; Snyder, L. R.; Horvath, C. An Introduction to Separation Science; John Wiley & Sons: Nashville, TN, 1973.

Text Books:

1. Skoog, D. A. Fundamentals of Analytical Chemistry, 7th ed.; Brooks/Cole: Florence, KY, 1995.
2. Crouch, S.; Skoog, D. A.; Holler, F. Fundamentals of Analytical Chemistry, 9th ed.; Brooks/Cole: Florence, KY, 2012.

3. Cram101 Textbook Reviews. Studyguide for Fundamentals of Analytical Chemistry by Skoog, Douglas A., ISBN 9780495558286; Cram101, 2017. Saunders College Publishing, Philadelphia, Holt, London.
4. Cram101 Textbook Reviews. Studyguide for Fundamentals of Analytical Chemistry by Skoog, Douglas A., ISBN 9780495558286; Cram101, 2017.
5. Christian, G. D.; Dasgupta, P. K.; Schug, K. A. Analytical Chemistry, 7th ed.; John Wiley & Sons: Chichester, England, 2013.
6. Christian, G. D. Analytical Chemistry, 6th ed.; John Wiley & Sons: Nashville, TN, 2004.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the theory and principles of Electroanalytical and Radio-analytical techniques.

CO2: Investigate the kinetics of electrode reactions

CO3: Analyze the constituents' elements simultaneously in a mixture of inorganic salts.

CO4: Determine the traces of metals (As, Pb and Hg.) in a mixture.

CO5: Apply various analytical techniques for the separation of organic and inorganic compounds.

CO6: Check the purity of a sample mixture and active pharmaceutical ingredients

CO7: Extract the mixture of compounds from the given samples.

CO8: Develop Competitive skills for various competitive examinations.

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

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO2, PO3/PSO3
CO3	PO5, PO2/PSO5
CO4	PO4,PO3/PSO4
CO5	PO2, PO5, PO1/PSO2
CO6	PO9,PO7/PSO3
CO7	PO10,PO11/PSO6
CO8	PO4,PO3/PSO4

BCHE 0006: GREEN CHEMISTRY AND CORROSION SCIENCE

Objective: To develop understanding of principles of green chemistry and corrosion science and their applications.

Credits: 04 **Semester III/IV/V/VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Green Chemistry Part-I** Introduction to Green Chemistry: Need for Green Chemistry. Goals of Green Chemistry. Limitations/Obstacles in the pursuit of the goals of Green Chemistry. Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/minimization of hazardous/toxic products; designing safer chemicals –different basic approaches.	16
II	**Green Chemistry Part –II** Selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions -use of microwaves, ultrasonic energy; selection of starting materials; careful use of blocking/protecting groups; use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products; prevention of chemical accidents; strengthening/development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. Green Synthesis of: BHT, methyl methacrylate, paracetamol. Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, methylbenzoate to benzole acid). Microwave -assisted reactions in organic solvents: Esterification, Fries rearrangement, Diels Alder Reaction, Decarboxylation.	16
III	**Corrosion:** Introduction, Consequences of corrosion, Classification, Electrochemical theory of corrosion, Galvanic series, Description of galvanic, pitting stress and inter-granular corrosion, Factors affecting corrosion- nature of metal, overvoltage, relative areas of the anode and cathode, pH of the medium, temperature and polarization, Corrosion prevention- materials selection and design, Inhibitors, cathodic and anodic protection, Metallic coating-galvanizing and tinning.	16

Reference/Text Books:

1. Fontana, M. G.; Greene, N. D. Corrosion Engineering, 2nd ed.; McGraw Hill Higher Education: Maidenhead, England, 1978.
2. Cicek, V. Corrosion Engineering, 1st ed.; John Wiley & Sons: Nashville, TN, 2014.
3. Ahmad, Z. Principles of Corrosion Engineering and Corrosion Control, 2nd ed.; Butterworth-Heinemann: Oxford, England, 2006.
4. Sheldon, R. A.; Arends, I.; Hanefeld, U. Green Chemistry and Catalysis, 1st ed.; Wiley-VCH Verlag: Weinheim, Germany, 2007.

5. Ahluwalia, V. K. Green Chemistry: Environmentally Benign Reactions; Ahluwalia, V. K., Ed.; CRC Press: Boca Raton, FL, 2007.
6. Green Chemistry: Frontiers in Benign Chemical Syntheses and Processes; Williamson, T. C., Anastas, P. T., Eds.; Oxford University Press: London, England, 1998.
7. Ahluwalia V.K.,KidwaiM.R., New Trends in Green Chemistry, Anamalaya Publishers (2005).

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the theory and principles of green chemistry and corrosion science.
CO2: Apply green chemistry principle for synthesis of organic and inorganic compounds.
CO3: Prevent and minimize the generation of hazardous substances in chemical processes
CO4: Classify different type of corrosion
CO5: Propose the mechanism for different type of corrosion
CO6: Synthesize of BHT, methyl methacrylate, paracetamol.
CO7: Develop Competitive skills.

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

COs	**POs/PSOs**
CO1	PO2/PSO1
CO2	PO2, PO7/PSO3
CO3	PO1, PO3/PSO1
CO4	PO5,PO10/PSO2
CO5	PO7, PO5, PO9/PSO4
CO6	PO11, PO2/PSO6
CO7	PO1, PO3/PSO1

BCHE 0008: POLYNUCLEAR AND HETEROCYCLIC COMPOUNDS

Objective: This course aims to develop deeper understanding of polynuclear hydrocarbons and heterocyclic compounds, their methods of synthesis, reactions and properties.

Credits: 04 **Semester: III/IV/V/VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Polynuclear Hydrocarbons:** Naming of fused system, Structure Elucidation, Physical Properties, Chemical Properties/ Reactions : Electrophilic aromatic substitution, Reactions, Mechanism and Orientation of electrophilic, Substitution in Naphthalene, Orientation of Disubstitution in Naphthalene, Addition Reactions, Oxidation **Naphthalene Derivatives:** Preparation, Properties of Naphthols (Similarities with Phenols and Differences from Phenols), Naphthylamines, Nitronaphthalenes, Naphthaquinones, Naphthalene Sulphonic Acids **Anthracene**: Occurrence, Nomenclature and Isomerism Structure elucidation, Physical properties and Chemical Properties / Reactions, Reduction and Oxidation, Electrophilic substitution reactions, Electrophilic addition reactions, Reaction with oxygen, Dimerization, Diels-Alder reaction, Reaction with Picric acid, Reaction with Benzyne, Mechanism of Electrophilic Addition and Substitution Reactions **Phenanthrene** Synthesis and properties of Phenanthrene and Its Derivatives	24
II	**Heterocyclic Compounds** Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction Derivatives of furan: Furfural and furoic acid.	24

Reference Books:

1. Carey, F. A.; Sundberg, R. J. *Advanced Organic Chemistry: Part A: Structure and Mechanisms*, 3rd ed.; Springer: New York, NY, 2013.
2. Miller, B. *Advanced Organic Chemistry: International Edition*, 2nd ed.; Pearson: Upper Saddle River, NJ, 2004.
3. Bruckner, R. *Advanced Organic Chemistry: Reaction Mechanisms*; Academic Press: San Diego, CA, 2001.
4. Lewis, D. E. *Advanced Organic Chemistry*; Oxford University Press: New York, NY, 2015.
5. March, J. *Advanced Organic Chemistry*, 4th ed.; John Wiley & Sons: Nashville, TN, 1992.

Text Books:

1. Pandit, V. *Advanced Level Organic Chemistry: Questions and Answers*; Vijay Pandit: London, England, 1980.
2. Carey, F. A. *Advanced Organic Chemistry: Part B: Reactions and Synthesis*, 1983rd ed.; Springer: New York, NY, 2013. https://doi.org/10.1007/978-1-4757-1821-8.
3. Mundy, B. P. *Advanced Organic Chemistry*; John Wiley & Sons: Chichester, England, 2010.
4. Sharma, R. R. G. *Advanced Organic Chemistry*; Pacific Books International, 2012.
5. Singh, A.; Singh, R. Textbook of Organic Chemistry; Campus Books International: New Delhi, India, 2005.
6. Tewari, K. S.; etc. A Textbook of Organic Chemistry, 2nd ed.; Sangam Books: London, England, 1999.
7. A Textbook on Organic Chemistry; New Central Book Agency: Delhi, India, 2010.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the basic principle of pericyclic and photochemistry.
CO2: Classify the pericyclic and photochemical reactions
CO3: Draw Woodward Hoffmann correlation diagrams for concerted reactions
CO4: Propose Mechanism for pericyclic and photochemical reactions.
CO5: Design the synthesis of Heterocyclic compounds
CO6: Differentiate five and six membered Heterocyclic compounds
CO7: Identify the name of a reaction and its mechanistic routes of synthesis of Heterocyclic compounds
CO8: Elucidate the structure of Heterocyclic compounds.
CO9: Develop Competitive skills.

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

COs	POs/PSOs
CO1	PO1/PSO2
CO2	PO5, PO8/PSO3
CO3	PO2, PO3/PSO4
CO4	PO5,PO7/PSO5
CO5	PO4, PO10, PO1/PSO1
CO6	PO9,PO3/PSO3
CO7	PO2,PO7/PSO2
CO8	PO3,PO2/PSO5

CO9	PO9,PO3/PSO3

BCHE0009: INORGANIC SPECTROSCOPIC TECHNIQUES

Objective: To impart conceptual aspects of ESR, IR, NMR, UV-vis, NQR, MS and electron spectroscopic techniques and their application.

Credits: 04 **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	**ESR spectroscopy:** ESR spectra of metal complexes: Zeeman interaction and energy levels, g factor, Ligand field effects, dipolar coupling, Hyperfine coupling and A parameter, super-hyperfine coupling. Orbital moment quenching and g values, Anisotropy in g and A values. ESR spectra of multielectron ion complexes. Zero field splitting and Kramer's degeneracy, ESR spectra of d1 to d^9 metal ions, ESR spectra of binuclear metal complexes. Some examples of biomolecules. NQR spectra	24
II	**IRspectroscopy** Infrared and studies of simple inorganic compounds and metal complexes: selection rules. Active and degenerate vibrations, effect of functionalization and symmetry change on IR. Changes in ligand vibrations on coordination with metal ion. Metal-ligand atom vibrations. **NMR spectroscopy:**Proton, Fluorine, phosphorousand Nitrogen, NMR of Inorganic compounds, contact and pseudo-contact shifts in paramagnetic complexes, Lanthanide complexes as shift reagents. **Mössbauer spectroscopy:**Introduction and principle (Splitting pattern)	24

Reference Books :

1. Nakamoto, K. Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part a: Theory and Applications in Inorganic Chemistry; John Wiley & Sons, 2009.
2. Inorganic Electronic Structure and Spectroscopy: Methodology Inorganic Electronic Structure and Spectroscopy V I - Methodology; Solomon, E. I., Lever, A. B. P., Eds.; John Wiley & Sons: Nashville, TN, 2006.
3. Lee, J. D. Concise Inorganic Chemistry, 4th ed.; Chapman and Hall: London, England, 1991.
4. Iggo, J. A. NMR Spectroscopy in Inorganic Chemistry; Oxford University Press: London, England, 2000.
5. Mössbauer Spectroscopy Applied to Inorganic Chemistry, 1989th ed.; Long, G. J., Grandjean, F., Eds.; Kluwer Academic/Plenum: New York, NY, 1989.

Text Books:

1. Parish, R. V. NMR, NQR, EPR, and Mössbauer Spectroscopy in Inorganic Chemistry; Ellis Horwood Ltd, Publisher: Harlow, England, 1990.
2. Malik, W. U.; Tuli, G. D.; Madan, R. D. Selected Topics in Inorganic Chemistry; S Chand: New Delhi, India, 2010.
3. Duan, X.; Gade, L. H.; Parkin, G.; Poeppelmeier, K. R.; Armstrong, F. A.; Takano, M.; Mingos, D. M. P. Inorganic Chemistry and Spectroscopy; Springer: Berlin, Germany, 2013.

Focus: This course focuses on employability and skills development aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the theory and principle of various spectroscopic techniques such as UV-VIS, IR, NMR, MS, ESR and NQR
CO2: Elucidate the structure of inorganic compounds on the basis of various spectroscopic techniques.
CO3: Interpret the spectra obtained in various spectroscopic techniques such as UV-VIS, IR, NMR, MS, ESR and NQR.
CO4: Predict the no. of signals in NMR Spectra, no. of vibration in IR Spectra, molecular ion and other fragmented ions in MS spectra and splitting pattern
CO5: Differentiate to closely related inorganic compounds
CO6: Calculate Zero field splitting and Kramer's degeneracy in ESR Spectra.
CO7: Characterize inorganic compounds on the basis of various spectroscopy.
CO8: Develop competency for different competitive examinations.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO10,PO11/PSO4
CO8	PO1, PO5, PO7/PSO2

BCHO 0101: NANOMATERIALS AND NANOTECHNOLOGY (OPEN ELECTIVE)

Objective: This course aims to expose the students:

- To impart the basic concepts of nanotechnology
- To develop understanding about application of nanomaterials.

Credits: 04 **Semester III/IV/V/VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	Introduction to nanotechnology, nanoscale, electromagnetic spectrum, top down and bottom up approach, particle size, chemistry and physics of nanomaterials, electronic phenomenon in nanostructures, optical absorption in solids, quantum effects. Nanomaterials, preparation of nanomaterials like gold, silver, different types of nano-oxides, Al2O3, TiO2, ZnO etc. Sol-gel methods, chemical vapour deposition, ball milling etc. Carbon nanotubes, preparation properties and applications like field emission displays.	16
II	Different types of characterization techniques like SEM, AFM, TEM& STM. Nanocomposites, nanofillers, high performance materials, polymer nanocomposites, nanoclays, nanowires, nanotubes, nanoclusters etc. Smart materials, self-assembly of materials, safety issues with nanoscale powders.	16
III	Nano manipulation: Micro and nanofabrication techniques, Photolithography, E-beam, FIBetc. Nanolithography: Soft lithography, photoresist materials. Introduction to MEMS, NEMS and Nano electronics. Introduction to bio nanotechnology and nanomedicines.	16

Reference Books/ Text Books:

1. Pathak, G. Handbook on Nanotechnology; Orange Books International, 2017.
2. Waser, R. Nanoelectronics and Information Technology: Advanced Electronic Materiels& Novel Devices; Waser, R., Ed.; Wiley-VCH Verlag: Weinheim, Germany, 2003.
3. Schulz, M. J. Nanoengineering of Structural, Functional and Smart Materials; Sundaresan, M. J., Schulz, M. J., Kelkar, A. D., Eds.; Taylor & Francis Group, 2006.
4. Fahrner, W. R. (wolfgang R.). Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques; Fahrner, W., Ed.; Springer: Berlin, Germany, 2010.
5. Nanostructured Materials: Applications, Synthesis and in-Situ Characterization, 1st ed.; Terraschke, H., Ed.; De Gruyter: Boston, MA, 2019.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the theory and principles of Nanotechnology and Nano Materials.

CO2: Synthesize nano materials of gold, silver, different types of nano-oxides, Al2O3, TiO2, ZnO etc. Sol-gel methods, chemical vapour deposition, ball milling.
CO3: Characterize nano materials using techniques like SEM, AFM, TEM& STM.
CO4: Fabricate nano materials using Photolithography, E-beam, FIB
CO5: Determine the morphology and topology of nano materials
CO6: Develop Competitive skills.

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

COs	**POs/PSOs**
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO4,PO8/PSO1

BCHO 0102: TECHNOLOGY OF SURFACE COATING

Objective: This course aims to expose the students:

- To impart the basic concepts of surface coating
- To develop understanding about protective coatings and its constituents.

Credits: 04 **Semester III/IV/V/VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	Film formation-Film forming compositions- properties- types of polymerization in film forming compounds - drying oils - composition -manufacturing procedure. Resins - types - natural resins and its extraction - alkyd resin- manufacturing - compositions -properties - various synthetic resins -chemical constitution - manufacturing procedures - diluents - thinners - plasticizers - driers -additives - anti settling agents in surface coating	16
II	Pigments - properties - types - white pigments - properties - manufacturing procedures – red pigments, green, blue and black pigments - properties and manufacturing procedure Formulation of exterior coating – interior, decorative, industrial, special purpose, marine, bituminous and powder coatings – manufacture of various paints	16
III	Corrosion-different types, mechanism and factors influencing corrosion-corrosion prevention-inhibitors and their applications-oxidation-aging of rubber-oxidation of metals and radiation damage-factors affecting the selection of materials for engineering purposes selection of suitable materials for construction in chemical industry.	16

Reference Books/ Text Books:

1. Payne, H. F. Organic Coating Technology: V. 2; John Wiley & Sons: Nashville, TN, 1961.
2. Food Drying Science and Technology: Microbiology, Chemistry, Application; Hui, Y. H., Farid, M. M., Fasina, O., Noomhorm, A., Welti-Chanes, J., Eds.; DEStech Publications: Lancaster, CA, 2007.
3. Morgans, W. M. Outlines of Paint Technology, 3rd ed.; Hodder Arnold: London, England, 1990.
4. Turner, G. P. A. Introduction to Paint Chemistry and Principles of Paint Technology; Springer: New York, NY, 2014.

Focus: This course focuses on employability aligned with CO's

Outcome:

After studying this course students will able to:

CO1: Understand the theory and principles of technology of surface coating.
CO2: Classify polymerization in film forming compounds.
CO3: Formulate interior and exterior coating.
CO4: Manufacture resins, pigments and paints
CO5: select the materials for engineering purposes and construction in chemical industry
CO6: Apply concepts of corrosion science to prevent the materials destruction.
CO7: Develop Competitive skills.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3, PO6/PSO5

BCHO 0103: MATERIAL SCIENCE & ENGINEERING

Objective: This course aims to expose the students:

- To impart the basic concepts of material science
- To develop understanding about selection based on properties for various applications

No Pre-requisites

Credits: 04 **Semester III/IV/V/VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	Structure of atom-present concept of atom-Rutherford's and Bohr's model-Bonding in solids, Types of solids-crystalline and amorphous solids-crystal systems, Bravais lattices-miller indices-coordination number-crystal defects-determination of crystal structure-X-ray diffraction-electron, diffraction methods-Properties of engineering, materials-mechanical properties -isotropy and anisotropy-elasticity, plasticity, toughness, resilience, tensile strength, ductility, malleability, brittleness, hardness, fatigue, creep, wear resistance, Poisson's ratio-stress-strain relation-true stress and true strain- Electrical and magnetic properties-resistivity -conductivity-ionic and electrical conductivity, semiconductors, superconductivity, insulators,	16
II	Ferroelectricity, piezoelectricity, magnetization, paramagnetism, ferromagnetism, and diamagnetism -technological properties-castability, machinability, weldability, solderability, workability, formability Non-ferrous metals and alloys-aluminium and its alloys-copper and its alloys-Nonferrous metals and alloys used for high temperature services and nuclear application, Organic polymers and its properties Ceramics-classification-comparison of ceramic and non-ceramic structures-properties and application of ceramics-composite materials-classification-general characteristics.	16
III	Corrosion-different types, mechanism and factors influencing corrosion-corrosion prevention-inhibitors and their applications Oxidation-aging of rubber-oxidation of metals and radiation damage Factors affecting the selection of materials for engineering purposes selection of suitable materials for construction in chemical industry. Introduction to nanomaterials.	16

Reference Books/ Text Books:

1. Vlack, V. Elements Materials Science Engineering, 7th ed.; Addison Wesley: London, England, 2003.
2. Ajayan, P. M.; Schadler, L. S.; Braun, P. V. Nanocomposite Science and Technology, 1st ed.; Ajayan, P. M., Schadler, L. S., Braun, P. V., Eds.; Wiley-VCH Verlag: Weinheim, Germany, 2006.
3. Perry, R. H.; Green, D. W. Perry's Chemical Engineers Handbook, 7th ed.; McGraw-Hill Education (ISE Editions): London, England, 1997.
4. Nanocomposite science and technology, Pulikel M. Ajayan, Wiley-VCH 2005

Focus: This course focuses on employability aligned with CO's

Outcome:
After studying this course students will able to:

CO1: Understand the chemistry of materials and their mechanical, electrical and magnetic properties
CO2: Apply the XRD techniques to study structural features of materials
CO3: Fabricate materials at atomic label by alloying
CO4: Propose the mechanism of organic polymerization and their chemical properties
CO5: Identify the applications of different materials
CO6: Design new materials for advanced applications.
CO7: Develop Competency for competitive examinations.

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

COs	POs/PSOs
CO1	PO1/PSO3
CO2	PO2, PO9/PSO4
CO3	PO3, PO6/PSO5
CO4	PO4,PO8/PSO1
CO5	PO1, PO5, PO7/PSO2
CO6	PO10,PO11/PSO4
CO7	PO3, PO6/PSO5

BCHO 0104: INTRODUCTION TO BIOPHYSICAL CHEMISTRY

Objective: This course aims to expose the students to the
•To impart the basic concepts of biophysical chemistry

Credits: 04 **Semester III/IV/V/VI** **L–T–P : 3–1–0**

Module No.	Content	Teaching Hours (Approx.)
I	General account of the chemical nature of living cells. Carbohydrates: Classification, configurations and conformations, sugar derivatives, structuraland storage polysaccharides. Amino acids: General properties, peptide bond, essential and non-essential amino acids.Lipids: Classification, properties of lipid aggregates, biological significance.	16
II	Nucleic acid: Chemical structure and base composition, double helical structures, Tm, super-coiled DNA. Protein chemistry: Classification, different levels of protein structure, forces stabilizing proteinstructure, protein folding, protein modification. Vitamins, water- and fat-soluble vitamins, deficiency and diseases.	16
III	Enzymes: Nomenclature, apoenzyme and holoenzyme, substrate specificity, coenzymes, factorsaffecting enzyme activity, regulation of enzyme activity, enzyme inhibition, isozymes,ribozymes. Water: Structure and interactions, water as solvent, proton mobility, acid-base reactions, pH and buffers, isoelectric pH. Photometry: Basic principles of UV-Visible spectrophotometry and colorimetry, instrumentation and application. Chromatography: Ion Exchange, partition, gel filtration and affinity chromatography their principles and applications.	16

Reference Books/ Text Books:

1. Cooper, A. Biophysical Chemistry; Abel, E. W., Ed.; Royal Society of Chemistry: Cambridge, England, 2004.
2. Allen, J. P. Biophysical Chemistry, 1st ed.; Wiley-Blackwell: Chichester, England, 2009.
3. Martin, R. B. Introduction to Biophysical Chemistry; McGraw-Hill: New York, NY, 1964.

Focus: This course focuses on employability aligned with CO's

Outcome:
After studying this course students will able to:
CO1: Understand the chemistry of living cell.
CO2: Elucidate the structure of bio-molecules
CO3: Predict the behavior, stability and modification of protein
CO4: Apply analytical techniques to study nature of bio-molecules.
CO5: Investigate the mobility pH and isoelectric point of amino acids.
CO6: Develop Competency.

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

COs	POs/PSOs
CO1	PO5/PSO1
CO2	PO11, PO9/PSO4
CO3	PO7, PO10/PSO5

CO4	PO1,PO4/PSO3
CO5	PO3, PO2, PO7/PSO6
CO6	PO5/PSO1

Course Curriculum

Master of Computer Applications

MCA 1st yr

[DEPARTMENT OF CHEMISTRY]

MCHS 0201: Environmental Science

Credits: 02 **Semester I** **L–T–P: 2–0–0**

Objective: To create awareness towards various environmental issues like global warming, urbanization, pollutions, ozone layer depletion etc; their causes and remedial steps for protecting impacted society.

Module No.	Content	Teaching Hours
I	**Basics of Environmental Studies, Ecosystem and Natural Resources:** **Environment:** Concept, Types, Introduction, Multidisciplinary Nature, Scope, Importance, Need of Creating Public Awareness about Environment, **Natural Environment:** Life on the Earth, Structure & Function of Atmosphere, Hydrosphere, Lithosphere and Biosphere. **Ecology and Ecosystem:** Definitions, Classification, Structure & Functions. **Natural Resources:** Introduction, Classification, Depletion, Conservation, Status and Challenges related to Water Resources, Mineral Resources and Forest Resources.	10
II	**Status and Challenges related to Energy Resources:** Fossil Fuels, Hydroelectricity, Nuclear Energy, Solar Energy, Biomass Energy and Other Alternative Energy Resources. **Human Activities and their Effects on Environment:** Effect of Agriculture, Housing, Mining, Transportation and Industries. **Environmental Pollution:** Causes, Effects and Control of Air Pollution, Water Pollution, Land Pollution and Noise Pollution. Solid Wastes and Hazardous Wastes: Introduction and Management. **Global Environmental Challenges:** Global Warming, Ozone Layer Depletion, Acid Rain, Urbanization and Overpopulation. Biodiversity: Status, Distribution, Depletion and Conservation.	10
III	**Environmental Problems and Protection** **Environmental Protection:** Role of Citizens, Role of NGOs, Role of Government, Role of International Agencies and Conventions. Environmental Education, Environmental Ethics.. **Tools of Environmental Protections:** Environmental Laws, Environmental Impact Assessment, ISO Certification, Environmental Economics, Concept of Ecological Footprints and Sustainable Development, Major Environmental Problems and Efforts towards Environmental Protection in India.	10

Text Book:

- S. Deswal & A. Deswal "Environment and Ecology", 1st edition, Danpat Rai & Co. ltd.

Reference Books:

- Anubha Kaushik "Perspective in Environmental Studies"5th edition New Age International Publishers New Delhi.
- Benny Joseph "Environmental Studies"2nd edition Tata McGraw-Hill Education New Delhi .
- R.K. Agrawal and V.K. Sangal "Environment and Ecology" 1st edition Krishna Prakashan Media.
- Ralph Homes, Tim Grant, Karli Verghese "Life Cycle Assessment: Principle, Practice and Prospects" CSIRO PUBLISHING (20 March 2009) Australia.
- G. Miller "Environmental Science: Working with the Earth"11th edition, Thomson Brooks/Cole; (October 11, 2005).
- A.K. De "Environmental Studies"bhartiya vidyapeeth institute of Environmental Education and Research Pune.

Course Outcomes

CO1. Students will be able to understand the environmental issues pertaining to day-to-day living; gain awareness for the need of environmental education vis-à-vis education for sustainable development.

CO2. Students will acquire knowledge in ecological perspective and value of environment, biotic components, ecosystem process: energy, food chain, water cycle etc.

CO3. Students will be able to understand water quality standards and parameters, assessment of water quality, air pollution, pollutants, acid rain, global climate change and greenhouse gases.

CO4. Students will learn to understand variety of social issues associated with environmental deterioration involving human components such as population, ethics and urban settlements.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs	POs/PSOs
CO1	PO5
CO2	PO4
CO3	PO6
CO4	PO3
CO5	PO8

Course Curriculum

M.Sc. Chemistry

w.e.f.

Session: 2020-2021

[DEPARTMENT OF CHEMISTRY]

[Institute of Applied Sciences & Humanities]

COURSE STRUCTURE

First Semester

S. No.	Code	Subject	L-T-P	Credits
1.	MCHC0101	Inorganic Chemistry -I	3-1-0	4
2.	MCHC0102	Organic Chemistry-I	3-1-0	4
3.	MCHC0103	Physical Chemistry-I	3-1-0	4
4.	MCHC0104	Analytical Chemistry	3-1-0	4
5.	MMAS0502 MCHS0101	(a) Mathematics for Chemists (GE1) (b) Biology for Chemists(GE1)	2-0-0	2
6.	BCSO00005	Fundamentals of Computer (GE2)	2-0-0	2
PRACTICALS				
7.	BCSO00074	Fundamentals of Computer Lab (GE2)	0-0-2	1
8.	MCHC0801	Advanced Chemistry Lab	0-0-4	2
			18-0-6	23

Second Semester

S. No.	Code	Subject	L-T-P	Credits
1.	MCHC0201	Inorganic Chemistry-II	3-2-0	4
2.	MCHC0202	Organic Chemistry-II	3-2-0	4
3.	MCHC0203	Physical Chemistry-II	3-2-0	4
4.	MCHC0204	Spectroscopy-I	3-2-0	4
PRACTICALS				
5.	MCHC0802	Physical Chemistry Lab	0-0-4	2
6.	MCHC0803	Inorganic Chemistry Lab-I	0-0-4	2
7.	MCHC0804	Organic Chemistry Lab-I	0-0-4	2
			16-0-12	22

Third Semester

S. No.	Code	Subject	L-T-P	Credits
1.	MCHC0301	Spectroscopy- II	3-2-0	4
2.	MCHC0302	Nano Science and Nanotechnology	3-2-0	4
3.	MCHC0303	Heterocyclic Chemistry	3-2-0	4
4.	MCHE0316	Corrosion Chemistry	3-2-0	4
PRACTICALS				
5.	MCHC0805	Inorganic Chemistry Lab-II	0-0-4	2
6.	MCHC0806	Organic Chemistry Lab-II	0-0-4	2
7.	MCHJ0960	Graduate Seminar (AEC-1)	0-0-2	2
			16-0-8	22

Fourth Semester

S. No.	Code	Subject	-T-P	Credits
1.	MCHC0401	Polymer Chemistry	3-2-0	4
2.	MCHC0402	Environmental and Green Chemistry	3-2-0	4
3.	MCHE0401	Chemistry of Selected Natural Products	3-2-0	4
4.	MCHE0402	Methods in Organic Synthesis	3-2-0	4
PROJECT				
5.	MCHJ0971	Dissertation	0-0-8	8
				24

Course Structure

Semester	Core Courses			Discipline Specific Elective			Open elective courses			Total Credits
	No. of papers	Credits (L+T/P)	Total credits	No. of papers	Credits (L+T/P)	Total credits	No. of papers	Credits (L+T/P)	Total credits	
I	4	16+2(P)	18	0	0	0	2	4+1	5	**23**
II	4	16+6(P)	22	0	0	0	0	0	0	**22**
III	3	12+4(P)	16	1	4	4		2(P)	2	**22**
IV	2	8	8	2	8+8(P)	16	0	0		**24**
Total credits for the course			**64**			**20**			**7**	**91**

Semester	Core Course (C)	Ability Enhancement Compulsory Course (AECC)	Ability Enhancement Elective Course (AEEC) (2) + Lab (1) (Skill Based)	Elective: Discipline Specific DSE	Elective: Generic (GE)
I	Inorganic Chemistry-I Organic Chemistry-I Physical Chemistry-I Analytical Chemistry Advanced Chemistry Lab		**Fundamentals of Computer SEC-1:** Theory (2) + Lab (1)		**Mathematics for Chemists (GE-1)** for PCB students at UG level **Biology for Chemists (GE-2)** for PCM students at UG level
II	Inorganic Chemistry-II Organic Chemistry-II Physical Chemistry-II Spectroscopy-I Inorganic Chemistry Lab-1 Organic Chemistry Lab-1 Physical Chemistry Lab				
III	Spectroscopy –II Nano Science and Nanotechnology Heterocyclic Chemistry Inorganic Chemistry Lab-2 Organic Chemistry Lab-2	**Graduate Seminar (AEC-1)**		**DSE-1**	
IV	Polymer Chemistry Environmental & Green Chemistry	**Dissertation (AEC-2)**		**DSE-2** **DSE-3**	

Core Courses (C)

S. No.	Course Name	Code	L-T-P	Credit	Min. Contact Hrs.
1.	Inorganic Chemistry-I	MCHC0101	3-2-0	4	48
2.	Organic Chemistry-I	MCHC0102	3-2-0	4	48
3.	Physical Chemistry-I	MCHC0103	3-2-0	4	48
4.	Analytical Chemistry	MCHC0104	3-2-0	4	48
5.	Inorganic Chemistry-II	MCHC0201	3-2-0	4	48
6.	Organic Chemistry-II	MCHC0202	3-2-0	4	48
7.	Physical Chemistry-II	MCHC0203	3-2-0	4	48
8.	Spectroscopy-I	MCHC0204	3-2-0	4	48
9.	Spectroscopy –II	MCHC0301	3-2-0	4	48
10.	Nano Science and Nanotechnology	MCHC0302	3-2-0	4	48
11.	Heterocyclic Chemistry	MCHC0303	3-2-0	4	48
12.	Polymer Chemistry	MCHC0401	3-2-0	4	48
13.	Environmental and Green Chemistry	MCHC0402	3-2-0	4	48
14.				52	

Core Courses Lab

S. No.	Course Name	Code	L-T-P	Credit	Contact Hrs.
1.	Advanced Chemistry Lab	MCHC0801	0-0-4	2	30
2.	Physical Chemistry Lab	MCHC0802	0-0-4	2	30
3.	Inorganic Chemistry Lab-1	MCHC0803	0-0-4	2	30
4.	Organic Chemistry Lab-1	MCHC0804	0-0-4	2	30
5.	Inorganic Chemistry Lab-2	MCHC0805	0-0-4	2	30
6.	Organic Chemistry Lab-2	MCHC0806	0-0-4	2	30
7.				12	

Discipline Specific Elective Papers: DSE

S. No.	Course Name	Code	L-T-P	Credit	Contact Hrs.
SEM III					
1	Bioinorganic Chemistry	MCHE0301	3-2-0	4	48
2	Chemistry of Biological Components	MCHE0302	3-2-0	4	48
3	Corrosion Chemistry	MCHE0316	3-2-0	4	48
4	Food Science and biotechnology	MCHE0304	3-2-0	4	48
5	Fertilizers, Cement, Ceramic, Glass and paint	MCHE0305	3-2-0	4	48
SEM IV					
6	Chemistry of Selected Natural Products	MCHE0401	3-2-0	4	48
7	Methods in Organic Synthesis	MCHE0402	3-2-0	4	48
8	Pharmaceutical Chemistry	MCHE0403	3-2-0	4	48
9	Chemical, Electrochemical cells and Biosensor	MCHE0404	3-2-0	4	48
10	Chemical Sugar and Pulp Industry	MCHE0405	3-2-0	4	48
11	Petroleum Chemistry and agrochemicals	MCHE0406	3-2-0	4	48
12	Soil and Water chemistry	MCHE0407	3-2-0	4	48
13	Material Science	MCHE0408	3-2-0	4	48

Discipline Specific Lab

S. No.	Course Name	Code	L-T-P	Credit	Contact Hrs.
1	Dissertation	MCHJ0971		8	

General Elective (Other Discipline) GE

S. No.	Course Name	Code	L-T-P	Credit	Contact Hrs.
1.	Mathematics for Chemists	MMAS0502	2-0-0	2	30
2.	Biology for Chemists	MCHS0101	2-0-0	2	30

Skill Enhancement Courses (SEC)

S. No.	Course Name	Code	L-T-P	Credit	Contact Hrs.
1.	Fundamentals of Computer	BCSO0005	2-0-0	2	24
2.	Fundamentals of Computer Lab	BCSO0074	0-0-2	1	24

Ability Enhancement Compulsory (AEC)

S. No.	Course Name	Code	L-T-P	Credit	Contact Hrs.
1	Graduate seminar	MCHJ0960		2	

DETAILED SYLLABUS

MCHC0101 INORGANIC CHEMISTRY-I

Course Objectives: To provide better and deeper understanding of chemical bonding, importance of symmetry and group theory, properties of main group elements, Lanthanides, actinides, bioinorganic chemistry and inorganic cages/clusters.

Credit: 4 **Semester-I** **L-T-P: 3-2-0**

Module No.	Content	Teaching Hours (Approx.)
I	**Chemical Bonding** Basic principles of bonding - covalent, ionic and metallic bonds, lattice energy, VSEPR theory, dπ – pπ bonds, theory of hybridization. LCAO method, σ, π and δ molecular orbitals, MO diagram of heteronuclear diatomic and triatomic molecules. **HSAB concept and non aqueous solvents**: Basis of HSAB concept, acid-base strength, hardness and softness, symbiosis, applications of HSAB concept. Acid-base concept in non-aqueous media, reactions in non-aqueous solvents (ammonia, sulphuric acid), super acid and super bases. **Chemistry of Main group elements** Structure and bonding in boranes, carboranes, metallo carboranes, Wades rules, borazines, phosphazenes, S, N- compounds. Silicates- Classification, structures, isomorphous replacement, pyroxenes, layered and vitreous silicates, zeolites and molecular sieves. **Chemistry of d and f block elements** Electronic configuration, oxidation states; aqueous, redox and complex chemistry, spectral and magnetic properties of compounds in different oxidation states, horizontal and vertical trends in respect of 3d, 4d, and 5d elements with references to Ti-Zr- Hf , Cr- Mo- W, Mn- Tc-Re and Pt group metals	30

II	**Lanthanide and Actinide Elements**; Nuclear stability, terrestrial abundance and distribution, relativistic effect, electronic configuration, oxidation states, aqueous-, redox and complex- chemistry; electronic spectra and magnetic properties. lanthanide and actinide contractions and their consequences. **Group Theory** Molecular symmetry, elements of symmetry and symmetry operations, products of operation, point group, classification of molecules into point group, reducible and irreducible representations, orthogonality theorem, character theorem, symmetry aspects of molecular orbitals. **Bioinorganic Chemistry** Scope, inorganic elements in biological systems, basic bioenergetics and active transport of cations across membranes, Na+ / K+ pump. Metallo-enzymes. **Metallic Clusters** M-M bond and metal atom clusters, halide clusters, Metal carbonyl clusters, sandwich compounds. Metal carbenes, higher boranes, carboranes, metallobranes and metallocarboranes,	30

Course outcome: After learning this course the students will be able to:

i. Understand, explain/describe/rationalize molecular structure and bonding using group theory, inorganic cages and clusters.

Text Book(s)

1. J. D. Lee, Concise Inorganic Chemistry, 4th edition, ELBS.
2. F. A. Cotton, R.G. Wilkinson, Advanced Inorganic Chemistry, 6th edition, John-Wiley & Sons, 1999.
3. Puri, Sharma and Kalia

Reference Book(s)

1. J. E. Huheey, E. A. Keiter and R. L., Keite, Inorganic Chemistry: Principles of Structure and Reactivity, 4th edition, Harper Collins 1993.
2. B. E. Douglas, D. H., McDaniel and J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd edition, John Wiley, 1993,
3. S. F. A. Kettle , Physical Inorganic Chemistry: A Coordination Chemistry Approach, Spektrum, 1996
4. Huheey, E. James, Inorganic Chemistry: Principles of Structure and Reactivity, 4th edition, Harper Collins College, 1993.
5. N.N. Greenwood and A. Earnshaw, Chemistry of the Elements, 2nd edition, Butterworth-Heinemann, A division of Read Educational & Professional Publishing Ltd., 2001.
6. B.N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd. New Delhi, 1976.

7. J.L. Stephen and M.B. Jeremy, Principles of Bioinorganic Chemistry, 2nd Edition, Panima Publishing Corporation, 2005.
8. Williams, An Introduction to Bioinorganic Chemistry
9. DC Harris and MD Bertolucci, Symmetry and Spectroscopy, Dover Publications, 1989.
10. K. Veera Reddy, Symmetry and Spectroscopy of Molecules, New Age International, 2007.

MCHC0102 ORGANIC CHEMISTRY-I

Course objective: To introduce and develop the conceptual organic chemistry, chemical bonding, aromaticity, stereochemistry of organic molecules. Also to give deeper insight the application of name reactions in the formation of carbon-carbon bond, carbon-heteroatom bond and reaction mechanisms for it.

Credit: 4 **Semester-I** **L-T-P: 3-2-0**

Module No.	Content	Teaching Hours (Approx.)
I	**Bonding, Nomenclature and Aromaticity** Delocalized chemical bonding, conjugation, Cross conjugation, resonance, hyper conjugation, tautomerism, aromaticity in benzenoid and nonbenzenoid compounds. alternant and non alternant hydrocarbons, Huckel's rule. annulenes, anti aromaticity, aromaticity, Homo aromaticity, bonds weaker than covalent, addition compound, crown ether complexes and cryptands, Inclusion compound, cyclo dextrins, Catenanes & rotaxanes. **Stability and Reactivity of Reaction Intermediates** Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. **Stereochemistry:** Conformational analysis of cycloalkanes, effect of conformation on reactivity. elements of symmetry, chirality, R-S nomenclature, diastereoisomerism in acyclic and cyclic systems, E-Z isomerisms, interconversion of Fischer, Newman and Sawhorse projections, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis, optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape, stereochemistry of the compounds containing nitrogen, sulphur and phosphorus, asymmetric synthesis.	30

II	**Structure and Reactivity** Resonance and field effects, steric effect, quantitative treatment: Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation, methods of determining reaction mechanism. **Addition to Carbon-Carbon Multiple Bonds** Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic ring. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation. **Addition to Carbon-Heteroatom Multiple Bonds** Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds acids, esters and nitriles. Addition of grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin, Robinson annulations, Dickmann, Hofmann-Loffler-Freytag, Stork-enamine Shapiro and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.	30

Course outcome: After learning this course the students will be able to:

i. Explain/demonstrate the unique features of organic reactions and its mechanism of carbon hetero and carbon carbon bond formation, stereochemistry,
ii. Identify and analyze the factors influencing the bond formation
iii. Apply the concept to solve related problems.

Text Book(s)

1. T. W. G. Solomons and C. B. Fryhle, *Organic Chemistry*, 9th edition, Wilely India Pvt. Ltd., 2009
2. R. T. Morrison and R. N. Boyd, *Organic Chemistry*, 6th edition, Pearson Com., 1992

Reference Book(s)

1. P. Volhardt and N. Schore, *Organic Chemistry: Structure and Function*, 5th edition, W. H Freeman & Co, 2006
2. L. G. Wade, *Organic Chemistry*, Pearson Education 6th edition, 2006.
3. R.M. Silverstein and F.X. Webster, *Spectroscopic Identification of Organic Compounds*, 6th edition, Wiley Inc.
4. J. March, *Advanced Organic Chemistry*, John Wiley & Sons, 1992.
5. E. J. Eliel, *Stereochemistry of Carbon Compounds*, McGraw Hill.
6. S. H. Pine, *Organic Chemistry*, McGraw Hill, 1987.
7. D. Nasipuri, *Stereochemistry of Organic Compounds*, Wiley, 1994.
8. P. Sykes, *A Guide Book to mechanism in Organic Chemistry*, 6th edition, Longman, 1989.
9. P.S. Kalsi, *Organic Reactions and their Mechanisms*, 2nd edition, New Age International Publishers, 2000.

10. S.M. Mukherji, S.P. Singh, *Reactions Mechanism in Chemistry*, Vol. I, II, III, Macmillan, 1985.
11. P.S. Kalsi, *Stereochemistry of Organic Compounds*, 2nd edition, New Age International, 1993.
12. W. Carruthers, *Modern Methods of Organic Synthesis*, 4th Edition Cambridge University Press, 2007.
13. C. K. Ingold, *Structure and mechanism of Organic Chemistry*,, Cornell University Press, 1999.
14. H. O. House, Modern Organic Reactions, , Benjamin, (1972).

MCHC0103 PHYSICAL CHEMISTRY-I

Course objective: To introduce to quantum mechanics, fundamentals of chemical kinetics and electro chemistry.

Credit: 4 **Semester-I** **L-T-P: 3-2-0**

Module No.	Content	Teaching Hours (Approx.)
I	**Chemical Kinetics** Methods of determining rate laws, collision theory of reaction rates, steric factor, Arrhenius equation and activated complex theory, kinetic and thermodynamic control of reactions, ionic reactions, kinetic salt effects, steady state kinetics, unimolecular reactions and their treatments (Lindemann-Hinshelwood and Rice-Ramsperger-Kassel-Marcus [RRKM] theory), Complex reactions (composite reactions, chain reactions), photochemical reactions, homogeneous catalysis, enzyme kinetics, effects of enzyme concentration, pH, temperature, activators and inhibitors on enzyme activity, studies of fast reactions by flow method, relaxation method, flash photolysis. **Electrochemistry** Debye-Huckel-theory and its applications, Electrolytic conductivity and the Debye-Hückel-Onsangar treatment, electrified interfaces, Electrochemical cells, Nernst equation, concentration cells with and without liquid junction, reversible and irreversible electrode, electrolysis and over-voltage, corrosion, electro-chemical sensors (glucose meter etc).	30
II	**Quantum Mechanics** Introduction to quantum mechanics, Schrödinger wave equation, eigen functions and eigen values, physical interpretation of wave function, concepts of operators: Laplacian, Hamiltonian, Linear and Hermition operators, angular momentum operators and their properties, commutation of operators, normalization, orthogonality and orthonormality of wave functions, average (expectation) values, postulates of quantum mechanics, solutions of Schrödinger wave equation for a free particle, particle in a ring, particle in a three dimensional box, application of Schrödinger equation to harmonic oscillator, rigid rotator, eigen functions and eigen values of angular momentum, Ladder operator method for angular momentum.	30

Course outcomes: After learning this course the students will be able to:

i. Understand and evaluate quantum mechanics
ii. Analyze the fundamentals of chemical kinetics and electrochemistry and apply the concepts to solving problems

Text Book(s)

1. P. Atkins and J. Paula, *Atkins' Physical Chemistry*, Oxford University Press, 8th edition,2006.
2. G. M. Barrow, *Physical Chemistry*, Tata McGraw-Hill, New Delhi, 5th edition, 1992.
3. B. R. Puri, L.R. Sharma, and M.S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 45th edition, 2011.

Reference Book(s)

1. F. L. Pilar, *Elementary Quantum Chemistry*, Dover Publications, Inc. NY, 2nd edition.
2. A.K. Chandra, *Introductions to Quantum Chemistry*, Tata McGraw Hill, 4th edition, 1994.
3. D.R. Crow, *Principles and Applications of Electrochemistry*, Chapman and Hall, London,4th edition, 1994.
4. J.W. Moore, R.G. Pearson, *Kinetics and Mechanism*, John Wiley and Sons, 2nd edition, 1981.
5. J.O'M. Bockris and A. K. N. Reddy, *Modern Electrochemistry*, Plenum Press, New York, Vol. 2 A & B, 2nd edition, 1998.
6. K. J. Laidler, *Chemical Kinetics*, Harper & Row, New York, , 1987.
7. I.N. Levine, *Physical Chemistry*, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 5th edition
8. K. L. Kapoor, *A Text Book of Physical Chemistry*, Macmillan India Ltd, Volumes 2 and 5, 3rd Edition 2004.

MCHC0104 ANALYTICAL CHEMISTRY

Course objective: To introduce concepts of various analytical and separation techniques.

Credit: 4 **Semester-I** **L-T-P: 3-2-0**

Module No.	Content	Teaching Hours (Approx.)
I	Accuracy, precision, sensitivity, specificity, standard deviation, classification of errors and their minimization, significant figures, criteria for rejection of data, Q-test, T-test and F-test, control chart, sampling methods, sampling error, **Radiochemical methods** Tracers in chemical analysis, isotopic exchange, isotopic dilution technique, labeling experiments in studying reaction mechanism. **Thermoanalytical and Electroanalytical Methods** Theory, methodology and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC). principles, techniques and applications of thermometric titration methods,	30
II	**Electrochemical methods:** Coulometry, Polarography, anode-stripping voltammetry, pulse techniques, cyclic voltammetry, electrogravimetry, spectroelectrochemistry. ameperometric and bioamperometric titrations **Separation Techniques** Solvent extraction: partition law and its limitations, distribution ratio, separation factor, factor influencing extraction, principle of chromatography, classifications of chromatography, techniques of planar and column chromatography, gas chromatography, high-performance liquid chromatography.	30

Course Outcome: After learning this course the students will be able to:

1. Analyze data handling/ statistical treatment of data.
2. Analyze and compute the data obtained from Potentiometric, Coulometric, and Voltametric methods of analysis.
3. Apply the chromatographic techniques in separation of compounds from mixture applications

Text Book(s)

1. R. L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, *Modern Methods of Chemical Analysis*, John Wiley, New York, 2nd edition, 1976.

2. G. D. Christian, *Analytical Chemistry*, John Wiley & Sons, New York, 5th edition, 1994.
3. D. A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, *Analytical Chemistry - An Introduction*, Saunders College Publishing, Philadelphia, London, 7th edition 2000.
4. J. H. Kennedy, *Analytical Chemistry: Principles*, Saunders Holt, London, 2nd edition, 1990.
5. Ewing G.W, *Instrumental Methods of Chemical Analysis*, McGraw Hill, 5th edition.
6. Day and Underwood, *Quantitative Analysis*, PHI, 6th Edition, 2009.
7. David Harvey, *Modern Analytical Chemistry*, McGraw Hill, 2000.

Reference books

1. G. D. Christian, *Analytical Chemistry*, John – Wiley and Sons Inc., 5th edition, 1994.
2. H. H. Willard, L. L. Merrit, J. A. Dean and F. A. Set, *Instrumental methods of Analysis.* CBS Publishers, 1996.
3. G. W. Ewing, *Instrumental methods of Chemical Analysis*, McGraw-Hill, New
4. York, 5th edition, 1988.
5. A.J. Bard & l. R. Faulkner, *Electrochemical methods*, Wiley, New York, 2nd edition, 2000.
6. Ed., Jeffery et., *Vogel's text book of Quantitative Chemical analysis* 5th edition, al ELBS/Longman, 1989.

MCHS0101 BIOLOGY FOR CHEMISTS

Course Objective: To introduce structure of cell, and understanding the function and organization of various bio-molecules present in the living cell.

Credit: 2 **Semester-I** **L-T-P: 2-0-0**

Module No.	Content	Teaching Hours (Approx.)
I	**Cell structure and function** Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells, overview of metabolic processes-catabolism and anabolism, ATP- the biological energy currency, origin of life- unique properties of carbon, chemical evolution and rise of living systems, introduction to biomolecules, building blocks of bio-macromolecules. **Carbohydrates** Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinosital, amino sugars, N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides, structural polysaccharides-cellulose and chitin, storage of polysaccharides-starch and glycogen, structure and biological functions of glucosaminoglycans or mucopolysaccharides, carbohydrates of glycoproteins and glycolipids, role of sugars in biological recognition, blood group substances, ascorbic acid, carbohydrate metabolism-Krebs' cycle, glycolysis, glycogenesis and glycogenolysis, gluconneogenesis, pentose phosphate pathway.	15
II	**Proteins** Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing, secondary structure of proteins, forces responsible for holding of secondary structures, a-helix, b-sheets, super secondary structure, triple helix structure of collagen, tertiary structure of protein-folding and domain structure, quaternary structure, amino acid metabolismdegradation and biosynthesis of amino acids, sequence determination: **Lipids** Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophopholipids, sphingolipids, cholesterol, bile	15

	acids, prostaglandins, lipoproteins-composition and function, role in atherosclerosis, bilayers, liposomes and their possible biological functions, biological membranes, fluid mosaic model of membrane structure, lipid metabolism-b-oxidation of fatty acids. **Nucleic acids** Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding, structure of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids, the chemical basis for heredity, an overview of replication of DNA, transcription, transpation and genetic code, chemical synthesis of mono and tri nucleosides.	

Course Outcome: After learning this course the students will be able to:

i. Molecular structure of carbohydrates, proteins, DNA, RNA, Carbohydrates, Lipids nucleic acids and Vitamins.

ii. Compute the organization and working of various components present in living cell.

Text books

1. J. D. Rawn, *Biochemistry*, Neil Patterson.
2. Voet, Voet *Biochemistry*, John Wiley.
3. E.E. Conn, P.K. Stumpf, *Outlines of Biochemistry*, John Wiley.

Reference Book(s)

1. A.L. Lehninger, *Principles of Biochemistry*, Worth Publishers.
2. L. Stryer, L. *Biochemistry*, W.H. Freeman.

MMAS 0502: MATHEMATICS FOR CHEMISTS

Course Objectives: To make the students understand the concepts of algebra, calculus and statistics by giving more emphasis to their applications in the field of chemistry.

Credits: 02 **Semester I** **L–T–P: 2–0–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Algebra:** Introduction to matrices, Determinant, Adjoint and Inverse of a matrix, Elementary operations, Rank of a matrix by Echelon form, Solution of system of linear equations by rank test and Cramer's rule, Revision of vector products, Point functions, Gradient, Divergence and Curl.	10
II	**Calculus:** Differentiation and integration of standard functions, Product, quotient and chain rules for differentiation, Extrema of functions of one variable, Integration by substitution, by parts and by partial fraction, Definite integral and its properties. Simple applications.	10
III	**Statistics:** Measures of central tendency and dispersion, Correlation and Regression, Fitting of straight line by method of least squares. Introduction to probability, Binomial and Poisson distributions.	10

Learning Outcomes:

After studying these topics, the student will be able to

- Understand differentiation and integration
- Find rank of a matrix & its applications in solving systems of linear equations
- Calculate the measures of central tendency and dispersion
- Find the gradient of a scalar point function and divergence, curl of a vector field

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Pub., Delhi, 2014.
- Mathematics books for Class XI & XII, NCERT Publications

Reference Books:

- P. Gupta, Comprehensive Mathematics (for Class XI & XII), Laxmi Pub. (P) Ltd. Delhi.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Statistics, Sultan Chand & Sons, Delhi, 2014.

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 **Semester I** **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.	9
II.	**Number System:** Bit, Byte, Binary, Decimal, Hexadecimal and Octal number systems and their inter-conversions. **Translator:** Assembler, compiler, interpreter, linker and loader **Introduction to Operating system:** definition, functions, CUI and GUI based operating systems. **Introduction to spreadsheet:** manipulation of cells, formulas and functions, printing of spreadsheet.	9
III.	**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.	8

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

- Familiar with the basic knowledge of computer.
- Able to use M.S. Office (M.S. Word, M.S. Power point, M.S. Excel and M.S. Access) and Internet efficiently.

Text Book:

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

Reference Books:

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

BCSO0074: FUNDAMENTALS OF COMPUTER LAB

(Open Elective)

Objective: To provide hands-on experience in Microsoft Office tools.

Credits: 01 **Semester I** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I+II	**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.	24

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

- Effectively use Microsoft Office tools such as MS Word, MS Excel and Power Point Presentation.

MCHC0801 ADVANCED CHEMISTRY LAB

Course Objective: To develop experimental skills of various separation and purification techniques, synthesis of smaller molecules, apply the concepts learnt about complexometric titrations and to optimize errors arising from various sources in titrimetric estimations, quantitative determination of viscosity, pH values and rate constant of a chemical reaction.

Credit: 2 **Semester I** **L-T-P: 0-0-4**

Module No.	Content	Teaching Hours (Approx.)
I+II	**Organic Chemistry** 1. Estimations of organic functional groups, e.g.: (i) glucose (ii) phenol (iii) glycine etc. 2. To determine corrected melting points of an unknown organic compound (calibration of thermometer). 3. Dibenzal acetone from benzaldehyde (Claisen-Schmidt reaction). 4. Nitration of nitro benzene and its reaction to M-nitro aniline 5. Acetanilide, bromoacetanilide, bromoaniline from aniline 6. Synthesis of methyl orange or methyl red. **Inorganic Chemistry** 7. Semi-micro qualitative analysis involving 4 radicals including interfering radicals. 8. Estimation of metal ions by gravimetric-cum-volumetric analysis (iii) Ba(II) gravimetrically and Ca(II) volumetrically. 9. Synthesis of simple coordination compounds: Chrome alum, tetraamine copper(II) sulphate. 10. Analysis of two cation-system using EDTA. 11. Conductometric titration of a weak acid with strong base. **Physical Chemistry** 12. Determination of pk_1 and pk_2 of dibasic acids. 13. Kinetics of saponification of an ester. 14. Determination of the equilibrium constant for $Kl + I_2 = KI_3$ reaction using partition method. **15.** Study of variation of angle of rotation with concentration of sucrose/tartaric acid using polarimetry. 16. Determination of percentage composition of a liquid mixture by viscosity measurement. 17. To compare cleansing power of two detergents.	

	18. To determine the critical micelle concentration of a soap by surface tension method.	

Course Outcome: After learning this course the students will be able to:

i. Apply Chromatographic separation techniques and identification of organic compounds.
ii. Apply Purification, Crystallization, and different Distillation processes
iii. Calculate enantiomeric composition by a polarimeter.
iv. Analyze and calculate physical properties of liquid and chemical kinetics of chemical reaction

MCHC0201 INORGANIC CHEMISTRY-II

Course objective: To understand the chemistry behind coordination of compounds, mechanism of metal complexes formation, analyze behavior and organometallic compounds, their stability and properties.

Credit: 4 **Semester-II** **L-T-P: 3-2-0**

Module No.	Content	Teaching Hours (Approx.)
I	**Coordination Chemistry** Crystal-Field theory, d-orbital splitting in octahedral, tetrahedral, square planar geometries, molecular orbital theory, p-bonding, Jahn-Teller effect, spectrochemical series, nephelauxetic series., ionic radii and heat of hydration, electronic Spectra, d-d transitions, Orgel and Tanabe-Sugano diagrams, charge-transfer spectra. Magnetism: Types, determination of magnetic susceptibility, spin-only formula, spin-orbit coupling, spin crossover. **Reaction mechanism of transition metal complexes**: Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, Conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage,	30
II	Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction, redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer-sphere type reactions, cross reactions and Marcus-hush theory, inner sphere type reactions. **Organometalic Chemistry** Organic-transition metal chemistry, Complexes with π-acceptor and σ-donor ligands, 18-electron and 16-electron rules, metal carbonyls, nitrosyls, carbenes, alkenes and allyl complexes, metallocenes, metal arene complexes, Reaction of organometallic complexes: substitution,	30

	oxidative addition, reductive elimination, insertion and elimination, electrophilic and nucleophilic reactions of coordinated ligands. Fluxional molecules, Industrial important organometalic catalyst: Wilkinsons catalyst, Ziegler-Natta catalyst, Monsanto process, Fischer-Tropsch process, Wacker process.	

Course outcome: After learning this course the students will be able to:

i. Understand the Chemistry of coordination compounds its stability and various theories of transition of electrons.
ii. Formulate the reaction mechanism of transition metal complexes.
iii. Evaluate the stability of organometallic compounds and clusters, and their applications as industrial catalysts.

Text Book(s)

1. J. D. Lee, *Concise Inorganic Chemistry*, 4th edition, ELBS.
2. F. A. Cotton, G. Wilkinson, P. G. Gans, *Basic Inorganic Chemistry*, 5th edition, John-Wiley & Sons, 1988.
3. Puri, Sharma and kalia

Reference Book(s)

1. J. E. Huheey, E. A. Keiter and R. L., Keiter, *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th edition, Harper Collins 1993.
2. S. F. A. Kettle, *Physical Inorganic Chemistry: A Coordination Chemistry Approach*, Spektrum, 1996.
3. A. B. P. Lever, *Inorganic Electronic Spectroscopy*, Elsevier, 1984, 2nd Ed.
4. R. R. Jordan, *Reaction Mechanism in Inorganic Chemistry*, Oxford Univ. Press, 1998. 2nd Ed.
5. L.T. Martin, J.Burgess, *Inorganic Reaction Mechanisms*, Longmans Ist Edn., (1999).
6. F. Basalo, R. G. Pearson, *Mechanism of Inorganic Reactions*, 2nd Edn (1967), Wiley
7. Eastern Ltd., New Delhi.
8. R. H. Crabtree, *Organometallic Chemistry of the Transition Metals*, John Wiley, 1993, 2nd Ed.
9. A.Yamamoto, *Organotransition Metal Chemistry: Fundamental Concepts and Applications*, John Wiley 1986.

MCHC0202 ORGANIC CHEMISTRY-II

Course Objective: To impart deeper understanding of substitution reactions, rearrangement reactions, applications of oxidizing and reducing agents in organic synthesis and advanced knowledge of pericyclic and photochemical reactions.

Credit: 4 **Semester-II** **L-T-P: 3-2-0**

Module No.	Content	Teaching Hours (Approx.)
I	**Rearrangements** Rearrangement reactions involving carbocation (Wagner-Meerwein, Pinacol-Pinacolone rearrangement), carbenes (Wolff & Arndt- Eistert synthesis), nitrenes (Hoffman, Curtius, Schmidt, Lossen, Beckman) and Fries rearrangement, Benzil-benzilic acid rearrangement, Arndt-Eistert reaction, Tiffeneau- Demjanov reaction, Firtsch-Buttenberg-Wiechell rearrangement, Stevens, Wittig and Favorskii rearrangements, Dienone-phenol, Baker-Venkatraman rearrangement, Baeyer-Villiger oxidation. Neber rearrangement, Benzidine rearrangement	30
II	**Common Organic Reagents** Synthesis and applications of BF_3, NBS, Diazomethane, Lead tetra-acetate, Osmium tetraoxide, Woodward Prevorst hydroxylation reagent, $LiAlH_4$, Grignard reagent, organozinc and organolithium reagent. Gilman's reagent, DCC, LDA, 1,3–dithiane (reactivity umpolung), trimethyl silyl iodide, Baker's Yeast, Phase-transfer catalysts. **Pericyclic Reactions** Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene and allyl system, classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach, electrocyclic reactions conrotatory and disrotatory motions 4n, 4n +2 and allyl system, cycloadditions-antarafacial suprafacial additions, 4n and 4n+2 systems, 2+2 additiion of ketenes, 1,3-dipolar cycloadditions, sigmatropic rearrangements, suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, [3, 3]-and [5, 5]-	30

	sigmatropic rearrangements, Claisen, Cope and aza-Cope rearrangement. Ene reaction. **Photochemistry** Photochemistry: Cis-trans isomerisation, Paterno-Buchi reaction, Norrish type I & II reaction, photoreduction of Ketones, dipimethane rearrangement, photochemistry of arenes, Barton reaction.	

Course Outcome: After learning this course the students will be able to:

i. Understand various aliphatic and aromatic substitutions and elimination reactions
ii. Conceptual understanding of rearrangement reactions.
iii. Synthesize and apply various reducing agents, oxidizing agents, in organic synthesis.
iv. Design molecular orbital symmetry and possibility of thermally and photochemically pericyclic reactions
v. Understand the basics of photochemical reactions of alkenes, carbonyl and aromatic compounds.

Text Book(s)

1. T. W. G. Solomons and C. B. Fryhle, *Organic Chemistry*, 9th edition, Wilely India Pvt. Ltd., 2009
2. R. T. Morrison and R. N. Boyd, *Organic Chemistry*, 6th edition, Pearson Com., 1992

Reference Book(s)

1. P. Volhardt and N. Schore, *Organic Chemistry: Structure and Function*, 5th edition, W. H Freeman & Co, 2006
2. L. G. Wade, *Organic Chemistry*, Pearson Education 6th edition, 2006.
3. J. March, *Advanced Organic Chemistry*, John Wiley & Sons, 1992.
4. E. J. Eliel, *Stereochemistry of Carbon Compounds*, McGraw Hill.
5. S. H. Pine, *Organic Chemistry*, McGraw Hill, 1987.
6. P. Sykes, *A Guide Book to mechanism in Organic Chemistry*, 6th edition, Longman, 1989.
7. P.S. Kalsi, *Organic Reactions and their Mechanisms*, 2nd edition, New Age International Publishers, 2000.
8. S.M. Mukherji, S.P. Singh, *Reactions Mechanism in Chemistry*, Vol. I, II, III, Macmillan, 1985.
9. W. Carruthers, *Modern Methods of Organic Synthesis*, 4th Edition Cambridge University Press, 2007.
10. C. K. Ingold, *Structure and mechanism of Organic Chemistry*,, Cornell University Press, 1999.
11. H. O. House, Modern Organic Reactions, , Benjamin, (1972).

12. S.M. Mukherji, S.P. Singh, *Pericyclic Reactions*, Macmillan India New Delhi, 1985.
13. O.P.Agarwal , Reaction and reagents

MCHC0203 PHYSICAL CHEMISTRY-II

Course Objective: To develop fundamentals of statistical thermodynamics, colligative properties, surface chemistry and to impart the knowledge of microwave, IR and Raman spectroscopy and their applications.

Credit: 4 **Semester-II** **L-T-P: 3-2-0**

Module No.	Content	Teaching Hours (Approx.)
I	**Statistical Thermodynamics** Thermodynamic probability and entropy, Maxwell-Boltzmann statistics, justification of the laws of thermodynamics, translational, rotational, vibrational and electronic partition functions of diatomic molecules, calculation of the thermodynamic functions including 'chemical potential', equilibrium constants and the 'Saha Ionization' formula, salient features of Bose-Einstein and Fermi-Dirac statistics, specific heat of solids. **Colligative Properties** Vapour pressure lowering, osmosis and osmotic pressure, vapour pressure lowering of an ideal solution, theories of semi-permeability, effect of osmosis and semi-permeability, reverse osmosis, boiling point elevation, freezing point depression, abnormal results and Vant's Hoff factor. **Surface Chemistry** Thermodynamics of surfaces, adsorption phenomena (mono- and multi-layer), Langmuir and B.E.T. isotherms, determination of surface area of solids, adsorption from solution, electrical phenomenon at interfaces, classification and properties of surfactants, hydrophobic interactions, micellization, thermodynamics of micellization, 'phase separation' and 'mass action' models, emulsion and 'reverse micelles', effect of micellization on the rate of chemical reactions, characterization of the surface of a solid by different experimental techniques, including photoelectron spectroscopy, ESCA, auger spectroscopy. Langmuir-Blodgett films, catalytic activity at surfaces	30

II	**Spectroscopy: Microwave, IR and Raman** **Microwave spectroscopy:** Classification of molecules, molecular requirement for rotational spectra, the molecule as a rigid rotor, non-rigid rotor, effect of isotopic substitution on the transition frequencies, intensities, stark effect, nuclear and electron spin interaction and effect of external field, application. **Infrared spectroscopy:** linear harmonic oscillator, features of vibrational rotational spectra, vibrational energies of diatomic molecules, zero point energy, frequency, force constant and bond strengths, molecules as an harmonic oscillator, morse potential energy diagram, the interaction of rotations and vibrations, molecules as vibrating rotator: fine structure of infra red bands, P, Q and R branches, breakdown of oppenheimer approximation, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtones, Thermal distribution of vibrational & rotational levels, factors affecting the band positions and intensities, analysis and application of infrared spectroscopy. **Raman spectroscopy:** Classical and Quantum theories of Raman effect, pure rotational, vibrational and vibrational-rotational raman spectra, coherent anti stokes and stokes lines, selection rules, mutual exclusion principle, resonance Raman spectroscopy, infra red *vs* raman spectroscopy.	30

Course Outcome: After learning this course the students will be able to:

- Understand the basic principles of statistical mechanics, which correlates the microscopic properties of systems with the macroscopic observables.
- Apply the concepts of surface chemistry in developing system.
- Understand Compute and analyze the date received from Microwave, Infrared-Vibration-rotation Raman and infra-red Spectroscopy and its applications for chemical analysis

Text Book(s)

1. P. Atkins and J. Paula, *Atkins' Physical Chemistry*, Oxford University Press, 8th edition,2006.
2. G. M. Barrow, *Physical Chemistry*, Tata McGraw-Hill, New Delhi, 5th edition, 1992.
3. B. R. Puri, L.R. Sharma, and M.S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 45th edition, 2011.

Reference Book(s)

1. L.K. Nash, *Elements of statistical thermodynamics*, Addison Weesley, 2nd edition, 1974.

2. S. Glasston, V.D. Nostrand, *Thermodynamics for chemists*, 1965.
3. A.W. Adamson, *Physical Chemistry of surfaces*, Interscience New York, 1972.
4. J.J. Bikerman, *Surface Chemistry: Theory and applications*, Academic press New York, 1972.
5. C.N. Banwell, McCash, *Fundamentals of Molecular Spectroscopy*, 4th Edition, Tata McGraw Hill, 2010.
6. G.M. Barrow, Introduction to molecular spectroscopy, McGraw Hill, 1964.

MCHC0204 SPECTROSCOPY-I

Course objectives: To apply the concept of molecular spectroscopy an important tool in molecular structure determination and characterization. To acquire the skills to elucidate the molecular structure by using UV-Visible, FTIR, NMR and Mass spectroscopy

Credit: 4 **Semester-II** **L-T-P: 3-2-0**

Module No.	Content	Teaching Hours (Approx.)
I	**Ultraviolet and Visible Spectroscopy** Introduction, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser – Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds, steric effect in biphenyls. **Infrared Spectroscopy** Introduction, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds), effect of hydrogen bonding and solvent effect on vibrational frequencies, FT-IR. **Nuclear Magnetic resonance spectroscopy** Theory of NMR, instrumentation, equivalent and non equivalent protons, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, relaxation process, factors influencing coupling constant 'J', classification to AX, A_2, AMX, ABC etc, spin decoupling, shift reagents, 2D-NMR, NOESY, FTNMR, advantages of FTNMR, use of NMR in medical diagnostics.	30
II	**NMR –^{13} C and Others** General considerations, multiplicity of signals, ^{13}C-proton coupled spectra, spin-spin splitting, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants, $^{13}C(^{1}H)$ decoupled spectra, Two dimension NMR Spectroscopy – COSY, NOESY, techniques, NMR studies of nuclei - ^{19}F and ^{31}P **Mass Spectroscopy** Theory, modes of ionization-EI, CI, FD and FAB, Instrumentation,	30

	factors affecting fragmentation, ion analysis, ion abundance, mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, base peak, isotopic mass peak, Mc-Lafferty rearrangement, nitrogen rule, high resolution mass spectrometry, examples of mass spectral fragmentation of organic compounds with respect to their structure determination. **Combined problems on UV, IR, NMR and MASS spectroscopy.**	

Course outcome: After learning this course the students will be able to:

i. Understand the basic principle of spectroscopy and will able to apply the concept in getting the information about the material
ii. Solve structural problems based on UV-Vis, IR, proton NMR, 13CNMR and mass spectral data.

Text Book(s)

1. R.M. Silverstein and F.X. Webster, *Spectroscopic Identification of Organic Compounds*, 6th edition, Wiley Inc.
2. D.L. Pavia, G.M. Lampman and G.S. Kriz, *Introduction to Spectroscopy*, 3rd edition, Harcourt Inc.

Reference Book(s)

1. P.S. Kalsi, *Spectroscopy of organic compounds*, New age international, 6th edition, 2004.
2. Y.R. Sharma, *Elementary organic spectroscopy- principles and applications*, S. Chand, 5th edition, 2007.
3. A.U. Rahman, *One and two dimensional NMR spectroscopy*, Elsevier, 2010.
4. W. Kemp, *Organic spectroscopy*, Macmillan, 3rd edition. 2009.
5. F.W. McLafferty, F. Turecek, *Interpretation of mass spectra*, 4th edition, , California, 1993.
6. J. R. Chapman, *Practical organic mass spectroscopy*, 2nd edition, , John Wiley, NY, 1993.
7. J.W. Copper, *Spectroscopic techniques for organic chemists*, John Wiley, NY, 1980.

MCHC08002 PHYSICAL CHEMISTRY LAB

Course Objectives: To develop skills & hand on experience in physical chemistry involving experiments of chemical kinetics, surface chemistry, thermodynamics, spectrophotometry, determination of viscosity and concentration of liquids etc.

Credit: 02 **Semester II** **L-T-P: 0-0-4**

Module No.	Content	Teaching Hours (Approx.)
I+II	1. To study the inversion of cane sugar by optical rotation measurement. 2. Conductometric titration of a weak acid with strong base. 3. Potentiometric titration of a strong acid with strong base using quinhydrone electrode. 4. Spectrophotometric determine the concentration of copper sulphate, potassium permanganate and potassium dichromate in their solution. 5. Verification of Freundlich adsorption isotherm for I_2, acetic acid and oxalic acid on charcoal. 6. Estimation of heat of neutralization for strong acid strong base, weak acid strong base or vice – versa, heat of hydration and solution of salts. 7. Determination of molecular weight of a high polymer (say polystyrene) by viscosity measurement. 8. Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH. 9. Determination of isoelectric point by viscosity measurement. 10. Determination of solubility and solubility product of sparingly soluble salts ($BaSO_4$) and AgCl.	40

Course outcome: After learning this course the students will be able to:

i. Understand physical chemistry from experimental point of view.
ii. Develop skills in titration techniques for quantitative analysis.
iii. Design the spectrophotemetirc experiments for concentration determination

Text Book(s)

1. Senior Practical Physical Chemistry: B.D. Khosla, V.C. Garg and A. Khosla
2. Experimental Physical Chemistry: V. Athawale and P. Mathur.

Reference Book(s)

1. Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.
2. Practical in Physical Chemistry: P.S. Sindhu

MCHC0803 INORGANIC CHEMISTRY LAB-I

Course objectives: To understand and design experiments for qualitative analysis of complex inorganic mixture and also to estimate various ions present in alloys, prepare different complexes

Credit: 2 **Semester II** **L-T–P: 0-0-4**

Module No.	Content	Teaching Hours (Approx.)
I+II	**1.** Semi-Micro Qualitative Inorganic Analysis of Complex Inorganic Mixtures containing not more than six (6) inorganic radicals. 2. Analysis of the given alloys: Coin, Gunmetal, Brass and Bronze. 3. To prepare a pure and dry sample of the following compounds: 1. Potassium tris(oxalato)aluminate(III) 2. Sodium hexa(nitro)cobaltate(III) 3. Potassium tris(oxalato)cobaltate(III) 4. Hexa(ammine)cobalt (III)chloride 5. Tetrapyridine copper(II)persulphate 6. Dinitrotetrapyridine nickel(II) 7. Lead tetraacetate 8. Mercury (tetraisothiocyanato)cobaltate(II).	

Course outcomes: After learning this course the students will be able to:

i. Analyze various ions present in alloys
ii. Estimate the amount of ions by complexometric and gravimetric methods
iii. Design, formulate and characterize various complexes.

Text Book(s)

1. A text Book of Quantitative Inorganic Analysis: A.I.Vogal.

Reference Book(s)

1. Applied Analytical Chemistry: Vermani.
2. Commercial Methods of Analysis: Shell & Biffen

MCHC0804 ORGANIC CHEMISTRY LAB-I

Course Objectives: To develop common organic chemistry laboratory practices & techniques for carrying out and monitoring a synthesis & extraction of natural products, and quantitative estimation/characterization of organic compounds.

Credit: 2 **Semester II** **L-T–P: 0-0-4**

Module No.	Content	Teaching Hours (Approx.)
I+II	1. Separation of the compounds and their identification through various steps, derivative preparation, checking the purity of components by melting point and TLC. **2. Isolation of** (i) Caffeine from tea leaves (ii) Lactose and casein from milk (iii) Cystine from human hair (iv) D (+) Glucose from cane sugar **3. Multi-step synthesis** (i) Benzanilide from benzene (ii) Benzilic acid from benzaldehyde (iii) Acetylaminocinnamic acid from glycine (iv) Acridone from anthranilic acid (v) Meta - Nitroaniline from benzene (vi) 5-Acetoxy-1,2-benzoxathiole-2 - one from hydroquinone (vii) 2' - Hydroxy - 4 - methoxyphenyl styryl ketone from resorcinol (Viii) p-nitrobenzanilide from Benzophenone **4.** Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography. 5. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.	

Course outcomes: After learning this course the students will be able to:

i. Understand organic chemistry from experimental techniques to perform qualitative analysis of organic compounds and mixtures.

ii. Synthesize some important organic compounds through known procedures
iii. Isloate and characterize natural products.

Text Book(s)

1. J. C. Gilbert, S.F. Martin, "Experimental Organic Chemistry. A Miniscale and Microscale Approach", Thomson 2006
2. A. I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford , P. W. G. Smith "Vogel's Textbook of practical organicchemistry", Prentice Hall 1996

Reference Book(s)

1. J. W. Zubrick "The Organic Chem Lab Survival Manual", Wiley 2010
2. L. M. Harwood, C. J. Moody, J. M. Percy "Experimental Organic Chemistry, Standard and Micro scale", 2nded., Blackwell Science 1999
3. P. G. M. Wuts, T. W. Greene "Greene's Protective Groups in Organic Synthesis", any edition, Wiley & Sons
4. W. L. G. Armarego, C. L. L. Chai, "Purification of Laboratory Chemicals" any edition, Elsevier
5. C. F. Wilcox, „Experimental Organic Chemistry, A Small-Scale Approach", MacMillan Publishing Company, New York 1988

MCHC0301 SPECTROSCOPY II

Course objectives: To introduce the fundamental principles of NMR, Mossbauer, photochemical fluorescence spectroscopy and laser spectroscopy with emphasis on its application in material development and characterization.

Credits: 04 **Semester III** **L–T–P: 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**NMR spectroscopy** Basics of Nuclear Magnetic Resonance Spectroscopy, and of Nuclear spin, idea about Nuclear resonance, Saturation, Shielding of magnetic nuclei, Larmor frequency, Block equation. Chemical shift, Factors influencing chemical shift and its measurements, Deshielding, Spin-spin interactions, spin-spin coupling, Factors influencing coupling constant 'J', Classification of various systems (ABX, AMX, ABC, A2B2 etc.), Spin decoupling. COSY, DEPT, NOSY, NOE, FT-NMR, 2D-NMR, Basic ideas about instrumentation. Use of NMR in medical diagnostics. **Mossbauer Spectroscopy:** Basic principles, Application of the technique to the studies of bonding, structures and oxidation state of Fe^{+2} and Fe^{+3} compounds.	30
II	**Photophyscial and Photochemical Fluorescence Spectroscopy**: Basics of fluorescence and phosphoresce spectroscopy. Measurement of fluorescence and phosphorescence and lifetimes, Introduction to time-resolved techniques for absorption and emission measurements, modern techniques, TCSPC, Fluorescence upconversion, Flash photolysis, pump-probe spectroscopy. Detection and kinetics of reactive intermediates, Photochromic reactions. **Laser** spectroscopy: Basic principle of laser, Einstein equation, and related coefficients, two level, three level and four level system. Solid state laser, Gas Laser, dye laser, quantum-dot laser, Random laser. CO2 laser, He-Ne laser, diode laser, Ti: Sapphire laser. Applications of laser, in research, medical science and industry.	30

Course outcome: After learning this course the students will be able to:

i. Apply the principles of magnetic resonance and other advanced spectroscopic techniques in elucidation of organic, inorganic and organometallic compounds.

ii.

Text Books:

1. Banwell and McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw Hill, 2010.
2. Peter Atkins , Julio de Paula, Ronald Friedman, Quanta, Matter, and Change: A molecular approach to physical chemistry, W. H. Freeman and Company, New York.
3. Virender K. Sharma, MOSSBAUER SPECTROSCOPY, John Wiley & Sons, Inc.

Reference Book

4. Donald A. McQuarrie, john D. Simon, PHYSICAL CHEMISTRY, A MOLECULAR APPROACH, University Science Books, Sausalito, California.

MCHC0302: NANOSCIENCE AND NANOTECHNOLOGY

Course Objectives: To understand and develop significance of nanoscale and types of CNT, different methods of preparation of nanomaterials and various tools for characterizing nanomaterials

Credits: 04 **Semester III** **L–T–P: 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Basic Concept** Nanoscience and Nanotechnology - Basic concept, history, definitions. Concepts of nano scale and nano effects with suitable examples. Nanomaterials, classification and their properties - One-dimensional, Two-dimensional and Three-dimensional and zero-dimensional nano materials with examples. Quantum mechanics for particle in one dimentional box to explain quantum confinement. Energy levels of nanoparticle with different dimensions, concept of quantum well, toxicity and green nanoscience. **Characterization of nanomaterials:** Fundamentals of various techniques, Basic principle of Powder XRD and their applications in nano-materials characterization: Extended x-ray absorption technique,	30
II	**Electron microscopy**: SEM/TEM, high resolution imaging (HRI), defects in nanomaterials, UV-Vis Spectroscopy electron energy-loss mechanisms, prospects of scanning probe microscopes (SPM), AFM, optical spectroscopy of metal / semiconductor nanoparticles and quantum-dot, surface Plasmon Raman spectroscopy. **Nanostructured Materials and their applications:** Quantum wells, Dots and wires, Metal/oxide nanoparticles, nanorods, nanowires, and nanofibers, Nanocrystals, Nanoshells, Semiconductor Quantum Dots- Excitons, Polymer nanoparticles, Core-Shell Structures of nanomaterials. Their synthesis, characterization and properties. Applications in material science, engineering, medical science, Bio-medical science, pharmaceutical science, Nano-spectroscopy, paint industry	30

Course Outcomes: After learning this course the students will be able to:

i. Understand the significance of nanoscale & its dimensions
ii. Aacquire knowledge of various characterization techniques
iii. Valuate the short term and longer term applications of nanomaterials

Text Books:

1. Textbook of Nanoscience and Nanotechnology, by B.S. Murty , P. Shankar, Baldev Raj, B.B. Rath, James Murday, Springer publication.
2. Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, John J. Moore, CRC Press.

Reference Book:

1. Basic Principles of Nanotechnology, Wesley C. Sanders, CRC Press.

MCHC0303 HETEROCYCLIC CHEMISTRY

Course objectives: To introduce nomenclature, properties, reactivities and synthesis, aromatic, and non aromatic heterocycles compounds and fused heterocyclic compounds.

Credits: 04 **Semester III** **L–T–P : 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Nomenclature of Heterocycles:** Replacement and systematic nomenclature (Hantzsch-Widman system) of monocyclic, fused and bridged heterocycles. **Aromatic Heterocycles:** General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in 1H NMRspectra, emperical resonance energy, delocalization energy and Dewar resonance energy). Heteroaromatic reactivity and tautomerism in aromatic heterocycles. **Non- aromatic Heterocycles:** Strain-bond angle and torsional strains and their conseqences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular Geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction. Stereo-electronic effects- anomeric and related effects Attractive interactions-hydrogen bonding and intermolecular nucleophilic-electrophilic interactions	25
II	**Heterocyclic synthesis:** Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition Reactions. Four-membered heterocycles: Synthesis and reactions of azetidines, oxetanes and thietanes. **Five membered rings:** with two heteroatoms: pyrazole, imidazole, oxazole, thiazole, isothiazole and benzofused analogs. **Benzo-Fused Five-Memberd Heterocycles**: Synthesis and reaction including medicinal applications of benzopyrroles, benzofurans and benzothiophenes **Benzofused six membered** rings with one, two and three heteroatoms: benzopyrans, quinolines, isoquinolines, quinoxazalines, acridines, phenoxazines, phenothiazines, benzotriazines, pteridines. **Large membered heterocycles:** azepines, oxepines, thiepines. Chemistry of porphyrins and spiro heterocycles.	23

Course Outcome: After learning this course the students will be able to:

i. Apply nomenclature rules to different heterocyclic compounds

ii. Understand reactivity of fused, five, six membered and smaller & larger heterocyclic compounds.

iii. Develop experimental techniques for synthesis of heterocyclic compounds

Text Books:

1. Gupta, R.R.; Kumar, M.; Gupta, V Heterocyclic Chemistry, Vol.1-3, Springer Verlag, 1998.
2. Katrizky, A.R.; Rees, C.W. Comprehensive Heterocyclic Chemistry, Pergamon Press.
3. Carey, F.A. & Sundberg, R. J. Advanced Organic Chemistry, Parts A & B, Plenum: U.S. (2004).
4. Carruthers, W. Modern Methods of Organic Synthesis Cambridge University Press (1971).
5. Acheson, R. M. Introduction to the Chemistry of Heterocyclic Compounds John Wiley & Sons (1976).
6. Alhuwalia, VK and Kidwai, M. New trends in Green Chemistry. Anamaya Publishers, New Delhi (2003).

Reference Books

1. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
2. Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
3. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical
4. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Paudler, Wiley-Inter Science.

MCHE0316 CORROSION CHEMISTRY

Course objectives: To provide conceptual basis of corrosion chemistry, mechanism and its applications in preventing the objects from corrosion.

Credits: 04 **Semester III** **L–T–P: 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Introduction and fundamental concept:** Redox reaction, Definition, Consequence, cause and classification of corrosion. Mechanism of dry corrosion, Oxide layer, Pilling-Bed worth rule. Corrosion due to other gases, liquid metal corrosion. **Mechanism of Wet / electrochemical corrosion**: release of hydrogen type, Absorption of oxygen type. Application of the thermodynamics and kinetics of electrochemical reactions to the understanding of corrosion phenomena such as, stress corrosion, Galvanic, water line, Caustic embrittlement, hydrogen embrittlement, concentration cell corrosion, pitting corrosion, Crevice corrosion, microbiological and soil corrosion.	**25**
II	**Corrosion in industries:** Factors influencing corrosion,: Steam Power Plant, Boiler. **Corrosion control:** Design and principle of selection of material, corrosion inhibitors: Anodic and Cathodic inhibitors, modification of environment, Surface coatings: metallic coating, inorganic coating and organic. Methods of coating application. Passivity. Electrochemical methods of corrosion inspection and monitoring.	**25**

Course outcome: After learning this course the students will be able to:

i. Understand the fundamental concepts of corrosion and mechanism involved in it.
ii. Identify and analyze the factors affecting corrosion.
iii. Design the structure to reduce intensity of corrosion.
iv. Apply the principle to develop new coating materials for prevention of corrosion.

Text Books:

1. M G Fonlana & N D Greene, Corrosion Science and Engineering. McGraw Hill Book Co., New York.

2. S N Banerjee, An introduction to corrosion and corrosion inhibition, Oxonian Press Ltd., New Delhi.

Reference Books

1. D Jones, Principles and prevention of corrosion Macmillan Publications New York, 1992.
2. D.Pletcher and F C Walsh, Industrial Electrochemistry, Vol. II, Blakrid Academic Professional, London, 1993.

MCHC0805 INORGANIC CHEMISTRY LAB II

Course objectives: To develop experimental skills of latest and greener multistep synthesis of nanoparticles, survey research literature, and collect/compile the information for preparing a scientific report.

Credits: 02 **Semester III** **L–T–P : 0–0–4**

Module No.	Content	Teaching Hours (Approx.)
I+II	1. Synthesis of gold nanoparticle, its characterization and particle size determination. 2. Synthesis of silver nanoparticle, its characterization and particle size determination. 3. Green synthesis of metal nanoparticle. 4. Synthesis of metal nanoparticle as a function of temperature and their size effect on temperature. 5. Synthesis of high molecular weight polymer. 6. Determination of hardness of polymer	

Course Outcome: After learning this course the students will be able to:

i. Develop green synthesis of metal nanoparticles
ii. Evaute and analyse the parameters influencing the sysnthesis of metal nanoparticles
iii. Design an experiment for the development of perfect experimental skills of multistep synthesis of nanoparticles.

Text Books :

1. Textbook of Nanoscience and Nanotechnology, by B.S. Murty , P. Shankar, Baldev Raj, B.B. Rath, James Murday, Springer publication.

Reference Books

1. Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, John J. Moore, CRC Press.

MCHC0806 ORGANIC CHEMISTRY LAB II

Course objective: To develop experimental skills of multistep organic synthesis through conventional methods and latest tools for literature survey literature, and collect/compile the information for preparing report.

Credits: 02 **Semester III** **L–T–P : 0–0–4**

Module No.	Content	Teaching Hours (Approx.)
I+II	1. Synthesis and reaction of following ring systems a) Four membered rings like Azetidines and their 2-Oxo-derivatives b) Five membered rings containing two heteroatoms: Pyrozaoles, Isoxazoles, Imidazoles and thiazoles 2. Synthesis of Paracetamole, Aspirin and Ibrufene drugs 3. Preparation (multistep synthesis) and characterization through spectroscopic techniques. a) Synthesis of Acridone b) Benzanilide from benzophenone c) Anthranilic acid from phthalic acid 4. Determination of Iodine value by Wij's solution 5. Formation of soap from vegetable oil.	

Course Outcome: After learning this course the students will be able to:

i. Design experiments for multistep synthesis of organic molecules.
ii. Formulation of soap from oil for various purpose
iii. Design experiment for synthesis of carbon-heteroatom bond formation.

Text Books:

1. Text book of practical organic chemistry, A. I. Vogel, Pearson, 5th Edition, Delhi, 2004.
2. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, Universities Press (India), 2000.
3. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
4. Tewari, K.S.; Vishnoi, N.K.; Mehrotra, S.N. A Textbook of Organic Chemistry, 2nd edition, Vikas Publishing House, 1976.

Reference Books:

5. Mann, F.G.; Saunders, B.C. Practical Organic Chemistry, 4th edition, New Impression, Orient Longman Pvt. Ltd., 1981.

MCHJ0960 GRADUATE SEMINAR

Course Objectives: To develop presentation skills and proficiency in group discussion, understanding a scientific problem to provide information about the process, types and patterns of communication.

Credits: 02 **Semester III** **L–T–P : 0–0–2**

Course outcome: After learning this course the students will be able to:

i. Develop self introduction and role play facilitate cultivation firmness of mind and empathy
ii. Design group discussion infuses team spirit and sense of competition
iii. Develop skills to listen regenerate transformations empathetically
iv. Develop body language enhances personality grooming
v. Develop reading enhances stylish accent productivity

MCHC0401 POLYMER CHEMISTRY

Course Objectives: To introduce the basic concepts of polymers, molecular weight determination and distribution. Understand kinetics and mechanism of addition, coordination and condensation polymerization, various polymerization techniques and learn evaluate the effect of polymer structure on mechanical, electrical and optical properties,

Credits: 04 **Semester IV** **L–T–P: 3–2–0**

Module No.	Content	Teaching Hours
I	**Introduction of Polymer Chemistry** History of Polymers; Classifications of Polymers, Sources of raw materials–Monomers–Polymers–Polymerization. **Types of Polymerizations**: Addition and Condensation Polymerizations. Definition and Classification of Plastics – General Properties – Historical development of plastic industry- future trends, Thermoplastics, Thermosetting, Engineering and High performance plastics. **Polymerization reactions with its Mechanism** Addition Polymerization – Free radical Polymerization, Step-wise Ionic Polymerization (Anionic Polymerization and Cationic Polymerization), Controlled polymerization reaction including Atom Transfer Radical Polymerization (ATRP), Group Transfer Polymerization (GTP), Reversible Addition Fragmentation Termination**,** Co-ordination polymerization **–** Condensation Polymerization , Ring opening Polymerization. **Polymerization techniques** Bulk, Solution, Emulsion, Suspension, Melt polymerization, Interfacial polycondensation techniques. **Molecular Weight(MW) and Molecular Weight Distribution(MWD)** Number Avg. MW, Weight Avg. MW, Viscosity Avg. MW and Sedimentation Avg. MW, Derivation of Mn and Mw. Degree of Polymerization and MW, Polydispersity and MWD in polymers. Determination of MW – Osmometry, Viscometry, Cryoscopy, Ebulliometry, Gel permeation chromatography (GPC) etc.	22
	Phases of Polymers: Glass transition temperature(Tg), Factors affecting the Tg, Melting point of polymers Characterization of phases: Thermogravimetric analysis(TGA), Diffferential scanning calorimetry(DSC) **Characteristics and uses of polymers** Purification & separation techniques of polymer, Polyamides – Nylon	25

II	6, 66 etc.; Acetal-Homopolymer & Co-polymer, Saturated polymers – PETP & PVTP; Polymers containing fluorine – PTFE, PVDF etc.; Polycarbonate; Thermoplastics Polyester, Poly urethane. **Advance Polymeric Materials** High tech-areas for applications of plastics. High temperature polymers. Polymer concretes and polymer reagents. Introduction-basic chemistry-General properties and applications of Ultra-high modulus fibers. **Plastic waste management** Introduction-Sources of plastics waste-Separation technologies, viz. sorting-Manual, automated, Density separation, Flotation, Solvent separation, Melt filtration, Separation of resin from fiber in waste FRP. Mechanical recycling of commonly used plastics, such as PP, PE, PET, etc. mixed waste recycling-co-extruded films waste, commingled waste Extrusion flow moldings for production of plastics lumbers, chemical recycling/feedstock recycling processes for recovery of oil. **Green plastics** – an overview. Environmental issues, policies and legislation in India. Plastics – Energy saving, Eco-friendly – Case studies, Life cycle analysis-a model.	

Course outcomes: After learning this course the students will be able to:

- **i.** Develop basic concepts of polymers, understand mechanism and kinetics of polymerization, polymerization techniques, molecular weight determination.
- **ii.** Apply knowledge for synthesis of polymers and design the mechanism involved in it.
- **iii.** Enable to interpret experimental data using the characterization techniques and structure-property relationship for their final semester research project.

Text Books:

1. R. Johanner Brandrup, Recycling and recovery of plastics, Hanser Publishers, New York, 1996.
2. Nabil Mustafa, Plastics Waste Management, Disposal Recycling and reuse, Marcel Dekker, Inc. New York, 1993.
3. Anthony L. Andrady (Ed.), "Plastics and the Environment", Wiley Interscience New York (2003).
4. R.J. Ehrig, Plastics Recycling, Products and Processes, Hanser Publishers, New York, 1992.
5. RP.Singh, C.K.Das, S.K. Mustafi, Polymer Blends and Alloys an Overview, Asian Books Pvt.Ltd, New Delhi, 2002.
6. Polymer Science – V. R. Gowariker

Reference Books

1. Polymer Science – J. Fried
2. Principles Of Polymer Systems- Rodrigue
3. Principles Of Polymer Chemistry- Ravve
4. Introduction Of Polymer Science- Georgelias
5. Principles of Polymer science – Bahadur and Sastry

MCHC0402 ENVIRONMENTAL AND GREEN CHEMISTRY

Course Objectives: To understand the importance of environmental and green chemistry in, remediation and perspective about environment and the global challenges. Also to understand different aspects of environmental, chemistry of atmosphere, soil, water and fundamental aspects of green chemistry.

Credit: 4 **Semester-IV** **L-T-P: 3-1-0**

Module	Content	Teaching Hours (Approx.)
I	**Environmental Chemistry**: Chemistry of Atmosphere: Composition and structure of atmosphere, global warming, Greenhouse effect, Ozone depletion, Photochemical smog, acid rain, Air sampling techniques, Sources, effects and monitoring of air pollutants by Instrumental methods, Control of air pollution, analysis of CO, nitrogen oxides, sulphur oxides, hydrocarbons and particulate matter. **Hydrosphere:** Water Pollution, Different types of water pollutants, Sources, characteristics and effects of water pollutants, ground water pollution, surface water pollution lake and river water, eutrophication, marine pollution, water pollutants, Monitoring of Water Pollutants. **Soil pollution**: Soil humus, soil fertility, inorganic and organic components in soil acid base and ion exchange reactions in soils, micro and macro nutrients wastes and pollutants in soil, introduction to geochemistry, solid waste management, treatment and recycling soil analysis, radioactive pollution, disposal of radioactive waste. **Water Treatments and analysis:** Principles of water and waste water treatment aerobic and anaerobic treatment, industrial waste water treatment heavy metal pollution, hard water, softening, purification of water for drinking purposes water treatment for industrial use electro-dialysis reverse osmosis other purification methods chemical speciation of elements. Treatment of Municipal Waste Water, Treatment of Industrial Waste Water, Environmental Impact	25

	Assessment process in India Color, odor, conductivity, TDS, pH, acidity, alkalinity, chloride, residual chlorine, hardness, trace metal analysis, elemental analysis ammonia nitrite, nitrate fluoride, sulphide, phosphate, surfactants, BOD, COD, non-dispersive IR spectroscopy, Chromatography etc.	
II	**Green Chemistry:** Basic principles of Green Chemistry, twelve principles of green chemistry and implementations, Toxicology and Green Chemistry, Atom Economy, Climate and Green Chemistry, Plastics and Green Chemistry, Energy and Green Chemistry. **Green Solution:** Use of degradable chemicals, Selection of starting materials, Designing biodegradable products, Green reaction conditions, Green catalysis, Ionic liquids, Supercritical fluids, Flourous phase reactions, Sustainable development, atom economy, environmental, E-factor, traditional and alternative commercial syntheses of ibuprofen, adipic acid and maleic acid etc, green chemistry in action developing foam, whitening agent, detergent builders, green insecticides, biosynthesis of synthetic chemical, Microwave and Ultrasound assisted reactions, Heterogeneous catalysis: Biocatalysis: Green analytical methods, Proliferation of solventless reactions; Noncovalent derivatization; Biomass conversion. Hazard assessment and mitigation in chemical industry.	**25**

Course Outcome After learning this course the students will be able to:

i. Demonstrate an understanding of environmental chemistry, viz. air, water and soil pollution and their relationships vis-a-vis environment.
ii. Apply the concept of green and sustainable chemistry in resolving the environmental issues.
iii. Develop critical thinking for speculating the forthcoming challenges to the environment and develop green solution in saving the planet.

Text Books:

1. G.S. Sodhi, Fundamental Concepts of Environmental Chemistry, 2nd Edition, Narosa publishing House, 2005.
2. M.N. Rao and A.K. Datta, Waste Water Treatment, 2nd Edition, Oxford Publications, 2007.
3. H. Kaur, Environmental Chemistry, 6th Edn, Pragathi Prakashan, Meerut, 2011.
4. K.H.Mancy and W,.J.Weber Jr. Wiley, Analysis of Industrial Waste Water, Interescience New York, 1971.

5. L.W. Moore and E. A. Moore, Environmental Chemistry, McGraw Hill Publication, New York, 2002.
6. S. M. Khopkar, Environmental Pollution Analysis, New Age International (P) Ltd, 1993.
7. V. K. Ahluwalia, M. Kidwai, New trends in Green Chemistry, New Age Publications, 2004.
8. Green Chemistry: Introductory Text. M. Lancaster Royal Society of Chemistry (London).
9. M. Benaglia, Recoverable and Recyclable Catalysts, Wiley publication.
10. J. Clark and D. Macquarrie, Handbook of Green Chemistry & Technology, Blackwell Publishing.

Reference Book(s):

1. Green Chemistry: Theory and Practice. P.T. Anastas and J.C. Warner. Oxford University Press.
2. Solid-Phase Organic Synthesis. K. Burgess. Wiley-Interscience.

MCHE0401 CHEMISTRY OF SELECTED NATURAL PRODUCTS

Objectives: To learn and understand the nomenclature techniques in heterocyclic compounds. To develop the conceptual understanding of isolation, structural and physiological action of alkaloids, steroids, terpenes, carbohydrates in living beings.

Credits: 04 **Semester IV** **L–T–P: 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Carbohydrates:** Introduction. Kiliani-Fischer synthesis, Determination of configuration of the monosaccharides, conformational analysis of monosaccharides. Synthesis of amino sugars (β-D- Glucosamine, galactosamine, N-acetylmuramic acid (NAMA), N-acetyl neuraminic acid NANA). C- and Nglycosides. Synthesis of aldonic, uronic, aldaric acids and alditols.Structure elucidation of sucrose and maltose.Structures of lactose, gentiobiose, and meliobiose.Photosynthesis of carbohydrates.	23
II	**Steroids:** Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone, Cortisone. Biosynthesis of steroids. **Alkaloids & Terpenoids** Definition, nomenclature, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring. Role of alkaloids in plants and their physiological action. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)- Coniine, Quinine and Morphine. Isolation synthesis and general methods of structure elucidation of Geraniol, α-Pinene, Camphor, Menthol, Zingiberene and Phytol. Biosynthesis of terpenoids.	27

Course Outcomes: After learning this course the students will be able to:

i. Understand chemistry of carbohydrates
ii. Perform the basic classification and role of alkaloids.
iii. Structural elucidation and degradation of alkaloids.
iv. Synthesis structure of alkaloids, isolation and structural determination of alkaloids, to learn about terpenoids and its classification.
v. To learn about carbohydrates and its types and application in living tissues.

Text Books:

1. Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthope and J.B. Harborne, Longman, Essex.
2. Organic Chemistry, Vol, I.L. Finar ELBS.
3. Stereoselective Synthesis: A Practical Approach, jM. Norgradi, VCH.
4. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
5. Nogradi, M. Stereoselective Synthesis: A Practical Approach, VCH.
6. Hostettmann, Kurt; Gupta, M.P.; Marston, A. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Harwood Academic Publishers.

Reference Books

1. Dev, Sukh Insecticides of Natural Origin, Harwood Academic Publishers.
2. Mann, J.; Davidson, R.S.; Hobbs, J.B.; Banthrope, D.V.; Harborne, J.B. Natural Products: Chemistry and Biological Significance, Longman, Essex.

MCHE0402 METHODS IN ORGANIC SYNTHESIS

Course Objective: To develop the concepts and critical thinking in bond forming/breaking reactions in organic synthesis and molecular rearrangements. Understand and region, stereo specific application of reagents in organic synthesis.

Credits: 04 **Semester IV** **L–T–P: 3–2–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Reagents in Organic Synthesis:** Recent methodologies using organometallic chemistry, Specially Pd, Ni, Rh, Cr, Fe complexes organic synthesis . Use of the following reagents in organic synthesis and functional group transformations: complex metal hydrides, Gilman's reagent (Lithium dimethyl cuprate), lithium di-isopropylamide (LDA), dicyclohexyl carbodiimide (DCC) and selenium dioxide (SeO2). **Protection of the following groups:** Principles of protection of carbon-carbon double bonds, alcohol, amine, carbonyl and carboxyl groups.	**20**
II	**Disconnection approach to syntheses of organic molecules:** An introduction to synthons and synthetic equivalents, conversion and FGI, selective reactions (Chemo-, regio- and stereoselective), formation of CC, C-O and C-N bonds. **(a) One Group C-C Disconnection:** Alcohols and carbonyl compounds, consideration of regioselectivity. Alkene synthesis and uses of acetylenes in organic synthesis. **(b)Two Group C-C Disconnection:** Diels Alder reaction, 1,3-difunctionalised compounds, α, β-unsaturated carbonyl compounds, 1,5-difunctionalised compounds. Michael addition and Robinson annulation. N-2-chloroethyl piperidine, cyclohexylpropanol, 3,4-diphenyl-3-hydroxy-butane-2-one, cyclohexane-1, 3-dione, carboxymethylcyclohexanone, α, β–unsaturated ketone, nitrocinnamaldehyde, citral, α-terpenol.	**30**

Course Outcomes: After learning this course the students will be able to:

i. Design and apply specific reagents and protection of various functional groups
ii. Develop mechanistic pathways of organic reactions.
iii. Develop retrosynthetic approach to planning organic syntheses.
iv. Design and synthesize the compound based on retro as well as synthetic routes developed.

Text Books:

1. Organic Chemistry, Vol, I.L. Finar ELBS.
2. Stereoselective Synthesis: A Practical Approach, jM. Norgradi, VCH.
3. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
4. Nogradi, M. Stereoselective Synthesis: A Practical Approach, VCH.

Reference Books:

1. Hostettmann, Kurt; Gupta, M.P.; Marston, A. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Harwood Academic Publishers.
2. Mann, J.; Davidson, R.S.; Hobbs, J.B.; Banthrope, D.V.; Harborne, J.B. Natural Products: Chemistry and Biological Significance, Longman, Essex.

MCHJ0971 PROJECT (DISSERTATION)

Course objective:

i. To encourage the students in research and innovation in frontier areas of chemistry.

ii. To introduce to various stages of research planning and implementation.

iii. To perform scientific research under the supervision of a faculty and learn to coordinate to work in group and independently.

iv. To learn different synthetic methodology and analytical techniques for carrying out scientific research problems particularly to collect and interpret data.

Credits: 8

Semester IV

Outcomes: After learning this course the students will be able to:

i. Demonstrate ability to plan and strategize a scientific research problem, and implement it with in areas in limited timeframe.

ii. Develop ability to work both in group as well as independently.

iii. Develop skills in keeping accurate/readable record of their experimental work.

iv. Apply knowledge of chemistry to handle laboratory equipment and hazardous chemicals.

v. Utilize sophisticated instruments for analysis, data collection and interpretation.

vi. Critically examine research articles, and improve their scientific writing/communication skills.

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Established vide U.P. Act 21 of 2010.

Course Curriculum

Ph.D. (Chemistry)

[DEPARTMENT OF CHEMISTRY]

[Institute of Applied Sciences & Humanities]

COURSE STRUCTURE

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	PAC9001	Recent Advances in Chemistry	4	0	0	4
2.	PAC9002	Spectroscopy and Analytical Techniques	4	0	0	4
3.		Research Methodology	4	0	0	4
						12

OR

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS
			LECTURE	TUTORIALS	PRACTICALS	
1.	PAC9001	Recent Advances in Chemistry	4	0	0	4
2.	PAC9002	Spectroscopy and Analytical Techniques	4	0	0	4
3.		Research Methodology	4	0	0	4
						12

DETAILED SYLLABUS

PAC9001: RECENT ADVANCES IN CHEMSTRY

Objective: This course aims to expose the scholars to the basics of organic chemistry and to develop concepts to understand advanced organic chemistry and their applications.

Credits: 04 **Semester I** **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours (Approx.)
I	**Organic reaction intermediates:** generation, stability and reactivity, aromaticity and nonaromaticity, organic reaction mechanisms involving addition, elimination and substitution reactions.	16
II	Concepts of acid-base, hard-soft acid base concept. Transition elements and co-ordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms and stability of metal complexes. **Supramolecular Chemistry:** Definition, supramolecular host-guest compounds, Molecular recognition, Applications in Transport process and carrier design, Biomolecules in daily life.	16
III	**Stereochemistry:** principles of stereochemistry, configurational and conformational isomers in acyclic and cyclic compounds. Stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction. **Green Chemistry:** Principles and applications, Green solvents. **Common named reactions and rearrangements**. Organic transformations and reagents-applications in organic synthesis (Chemo, region and stereo selective transformations). .	16

Reference Books/ Text Books:

- *Essentials of Physical Chemistry*: Bahl & Tuli S.Chand & Co.
- *Elements of Physical Chemistry*: S. Glasstone D. Van Nostrand company, inc., 1946
- *Organic Chemistry* T. W. Graham Solomons, Craig B. Fryhle, and Scott A. Snyder John wiley & Sons
- Stereochemistry of Organic Compounds E. L. Eliel and S H Wilen John wiley & Sons
- *Organic Chemistry* Morrison & Boyd:
- *Molecular reactions and photochemistry* Charles H. DePuy and Orville L. Chapman
- *Advance organic chemistry* FA Carey & RA Sundberg, Springer

Focus: This course focuses on employability and skill development aligned with CO's.

Outcome:
After studying this course students will able to:

CO1: Apply the concept of product analysis, intermediates, isotope effects kinetic and stereochemical studies to determine the reaction mechanism.
CO2: Identify the reaction intermediates such as carbocation, carbanion, free radical, carbene, nitrene and arynes formed during a chemical reaction.
CO3: Propose mechanism for aromatic electrophilic substitution reactions of aromatic compounds.
CO4: Design the mechanistic route for synthesis of various hydrocarbons
CO5: Apply Huckel's rule to predict the aromaticity of organic compounds
CO6: Assign absolute configuration of different organic compounds

PAC9002: SPECTROSCOPY AND ANALYTICAL TECHNIQUES

Objective: To provide fundamental principles and applications of various spectroscopic techniques like UV-VIS, IR, NMR and MS, AAS, AES and other chromatographic techniques like HPLC, GC etc.

Credits: 04 **Semester I** **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours (Approx.)
I	Nanoscience and nanotechnology in chemistry Fundamentals of SEM/TEM techniques.	16
II	Ultraviolet Spectroscopy: Introduction. Studies of conjugated and extended conjugated systems etc. Woodward rules. Electronic spectra of transition metal complexes. Atomic Absorption spectroscopy: basic concepts and applications Infrared Spectroscopy: Introduction. Identification of functional groups, hydrogen bonding etc., metal ligand vibrations.	16
III	Nuclear Magnetic Resonance Spectroscopy: Introduction. Application of ^{1}H and ^{13}C NMR spectroscopy including COSY, NOESY, NOE techniques in the structural determination of complex organic systems. Mass Spectrometry: Basic concepts. Fragmentation and rearrangements (including McLafferty rearrangement) of different classes of organic molecules. Isotope effects etc. Chromatography: Basic concepts and Classification, column chromatography (GC, HPLC).	16

Reference Books/ Text Books:

- *Modern Methods of Organic Synthesis* W. Carruthers, Iain Coldham, Cambridge University Press
- *B. K. Sharma*, Krishna Prakashan Media,
- *Organic Spectroscopy* William Kemp, Macmillan
- *Organic Chemistry* T. W. Graham Solomons, Craig B. Fryhle, and Scott A. Snyder John wiley & Sons
- *Introduction to nanoscience and nanotechnology* by K K Chattopadhyay PHI learning pvt ltd.
- *Spectroscopy of Organic compound* by P S Kalsi New Age International

Focus: This course focuses on employability and skills development aligned with CO's

Course Outcome:

After studying this course students will be able to:

CO1: Understand the theory and principle of various spectroscopic techniques such as UV-VIS, IR, NMR and MS.

CO2: Apply Woodward-Fieser rules to calculate of λmax of organic compounds.

CO3: Elucidate the structure of organic compounds Interpret the spectra obtained in various spectroscopic techniques such as UV-VIS, IR, NMR and MS.

CO4: Predict the no. of signals in NMR Spectra, no. of vibration in IR Spectra, molecular ion and other fragmented ions in MS spectra.

CO5: Determine molecular weight and molecular formula using mass spectrometry

GLA UNIVERSITY
MATHURA
Recognised by UGC Under Section 2(f)

Accredited with A Grade by NAAC

12-B Status from UGC

Course Structure

M.Sc. Mathematics

[DEPARTMENT OF MATHEMATICS]

[Institute of Applied Sciences & Humanities]

First Semester

Paper No.	Code	Title	L-T-P-J	Credits
Paper-I	MMAC0001	Real Analysis	3-1-0-0	4
Paper-II	MMAC0002	Abstract Algebra	3-1-0-0	4
Paper-III	MMAC0003	Ordinary Differential Equations	3-1-0-0	4
Paper-IV	MMAC0004	Linear Algebra	3-1-0-0	4
Paper-V	MCAC0016	Programming in Python (SEC)	3-0-0-0	3
PRACTICALS				
Paper-VI	MCAC0810	Python Programming Lab (SEC)	0-0-4-0	2
				21

Second Semester

Paper No.	Code	Subject	L-T-P-J	Credits
Paper-I	MMAC 0005	Statistical Analysis	3-1-0-0	4
Paper-II	MMAC 0006	Operational Research-I	3-1-0-0	4
Paper-III	BCSC 0003/ MMAC 0007	Database Management System/ Topology	3-0-0-0/ 3-1-0-0	3/4
Paper-IV	BCSO 0007/ MMAC 0008	Data Mining for Business Analytics /Complex Analysis-I	4-0-0-0/ 3-1-0-0	4
Paper-V	MMAC 0101/ MMAC 0009	Probability and Stochastic Processes /Functional Analysis	3-1-0-0	4
Paper-VI	MELH 0006	Technical Writing (AECC)	4-0-0-0	4
PRACTICALS				
Paper-VII	MMAK 0801	Statistical Analysis Lab with R-Programming (SEC)	0-0-2-0	1
Paper- VIII	BCSC 0802	Database Management System Lab	0-0-2-0	1
				25

Third Semester

Paper No.	Code	Subject	L-T-P-J	Credits
Paper-I	MMAC 0010	**Partial Differential Equations-I**	**3-1-0-0**	**4**
Paper-II	MMAC 0011	**Operational Research-II**	**3-1-0-0**	**4**
Paper-III	BCSO 0008/ MMAC 0012	**Predictive Analytics for Data Analyst /Complex Analysis- II**	**4-0-0-0/ 3-1-0-0**	**4**
Paper-IV	BCSE 0556, BCSE 0106, MMAE 0009, MMAE 0011 BCSO0009-0012/ MMAE0001-0015	**Discipline Specific Elective I (DSE I)**	**3-0-0-0/ 3-1-0-0/ 4-0-0-0**	**3/4**
Paper-V	BCSE 0556, BCSE 0106, MMAE 0009, MMAE 0011 BCSO0009-0012/ MMAE0001-0015	**Discipline Specific Elective II (DSE II)**	**3-0-0-0/ 3-1-0-0/ 4-0-0-0**	**3/4**
Paper-VI	BELH 0006/ BCHS 0201	**Open Elective (OE I)**	**2-0-0-0**	**2**
PRACTICALS *				
***Subject to the choice of discipline specific elective (s).**				
				22*

Fourth Semester

Paper No.	Code	Subject	L-T-P-J	Credits
Paper-I	BCSE 0556, BCSE 0106, MMAE 0009, MMAE 0011 BCSO 0009-0012/ MMAE0001-0015	**Discipline Specific Elective III (DSE III)**	**3-0-0-0/ 3-1-0-0/ 4-0-0-0**	**3/4**
Paper-II	MMAC 0013	**Numerical Analysis**	**4-0-0-0**	**4**
Paper-III	BELH 0006/ BCHS 0201	**Open Elective (OE II)**	**2-0-0-0**	**2**
PROJECT				
Paper-IV	MMAJ 0961	**Dissertation (AECC)**	**0-0-0-12**	**12**
PRACTICAL *				
***Subject to the choice of discipline specific elective (s).**				
				22*

Semester	Core Courses (including SEC and AECC)			Discipline Specific Electives			Open Electives			Total Credits
	No. of Papers	Credits (L+T/P)	Total Credits	No. of Papers	Credits (L+T/P)	Total Credits	No. of Papers	Credits (L+T/P)	Total Credits	
I	5	4/3+2(P)	21	0	0	0	0	0	0	**21**
II	7	4/3+1(P)	25	0	0	0	0	0	0	**25**
III	3	4	12	2	4	8	1	2	2	**22**
IV	1	4 +12(J)	16	1	4	4	1	2	2	**22**
Total credits of the course			**74**			**12**			**4**	**90**

Core Courses © – Theory

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Real Analysis	MMAC 0001	3-1-0-0	4	40
2.	Abstract Algebra	MMAC 0002	3-1-0-0	4	40
3.	Ordinary Differential Equations	MMAC 0003	3-1-0-0	4	40
4.	Linear Algebra	MMAC 0004	3-1-0-0	4	40
5.	Statistical Analysis	MMAC 0005	3-1-0-0	4	40
6.	Operational Research-I	MMAC 0006	3-1-0-0	4	40
7.	Topology	MMAC 0007	3-1-0-0	4	40
8.	Complex Analysis-I	MMAC 0008	3-1-0-0	4	40
9.	Functional Analysis	MMAC 0009	3-1-0-0	4	40
10.	Partial Differential Equations-I	MMAC 0010	3-1-0-0	4	40
11.	Operations Research- II	MMAC 0011	3-1-0-0	4	40
12.	Complex Analysis -II	MMAC 0012	3-1-0-0	4	40
13.	Numerical Analysis	MMAC 0013	3-1-0-0	4	40
14.	Database Management System	BCSC 0003	3-0-0-0	3	30
15.	Data Mining for Business Analytics	BCSO 0007	4-0-0-0	4	40
16.	Probability and Stochastic Processes	MMAC 0101	3-1-0-0	4	40
17.	Predictive Analytics for Data Analyst	BCSO 0008	4-0-0-0	4	40

Core Courses © – Practical

S. No.	Lab Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Database Management System Lab	BCSC 0802	0-0-2-0	1	24

Discipline Specific Elective Papers: DSE (Theory)

BOUQUET (For Data Analytics)

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Hadoop and Big Data Analytics	BCSE 0556	3-0-0-0	3	30
2.	Machine Learning and its Applications	BCSE 0106	3-0-0-0	3	30
3.	Social Web and Mobile Analytics	BCSO 0009	4-0-0-0	4	40
4.	Introduction to Virtualization and Cloud Computing	BCSO 0010	4-0-0-0	4	40
5.	Digital Marketing and Transformation	BCSO 0011	4-0-0-0	4	40
6.	Data Warehouse	BCSO 0012	4-0-0-0	4	40
7.	Discrete Mathematics	MMAE 0009	4-0-0-0	4	40
8.	Optimization Techniques	MMAE 0011	4-0-0-0	4	40

Discipline Specific Elective Papers: DSE (Practical)

BOUQUET (For Data Analytics)

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Hadoop and Big Data Analytics Lab	BCSE 0585	0-0-2-0	1	20
2.	Machine Learning Lab	BCSE 0133	0-0-2-0	1	20

BOUQUET (For Mathematics)					
S. No.	**Course Name**	**Code**	**L-T-P-J**	**Credit**	**Contact Hrs.**
Bouquet 1: Relativity and Cosmology					
1.	Differential Geometry	MMAE 0001	4-0-0-0	4	40
2.	Special Relativity and Tensor Calculus	MMAE 0002	4-0-0-0	4	40
3.	General Relativity and Cosmology	MMAE 0003	4-0-0-0	4	40
Bouquet 2: Applied Mathematics					
1.	Special Functions	MMAE 0004	4-0-0-0	4	40
2.	Number Theory	MMAE 0005	4-0-0-0	4	40
3.	Partial Differential Equations -II	MMAE 0006	4-0-0-0	4	40
4.	Fluid Dynamics – I	MMAE 0007	4-0-0-0	4	40
5.	Fluid Dynamics - II	MMAE 0008	4-0-0-0	4	40
6.	Discrete Mathematics	MMAE 0009	4-0-0-0	4	40
7.	Integral Equations and Calculus of Variations	MMAE 0010	4-0-0-0	4	40
8.	Optimization Techniques	MMAE 0011	4-0-0-0	4	40
9.	Non-Linear Programming	MMAE 0012	4-0-0-0	4	40
Bouquet 3: Analysis					
1.	Operator Theory	MMAE 0013	4-0-0-0	4	40
2.	Measure Theory and Integration	MMAE 0014	4-0-0-0	4	40
3.	Fixed Point Theory	MMAE 0015	4-0-0-0	4	40

Skill Enhancement Courses (SEC)

S. No.	**Course Name**	**Code**	**L-T-P-J**	**Credit**	**Contact Hrs.**
1.	Programming in Python	MCAC 0016	3-0-0-0	3	36
2.	Programming in Python Lab	MCAC 0810	0-0-4-0	2	24
3.	Statistical Analysis Lab with R-Programming	MMAK 0801	0-0-2-0	1	20

Ability Enhancement Compulsory (AECC)

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Technical Writing	MELH 0006	**4-0-0-0**	4	40
2.	Dissertation	MMAJ 0961	**0-0-0-12**	12	---

Open Elective Courses (OE)

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Ethics and Values	BELH 0006	**2-0-0-0**	2	20
2.	Environmental Studies	BCHS 0201	**2-0-0-0**	2	20

GLA UNIVERSITY
MATHURA
Recognised by UGC Under Section 2(f)

Accredited with A Grade by NAAC

12-B Status from UGC

Course Structure

M.Sc. Mathematics

[DEPARTMENT OF MATHEMATICS]

[Institute of Applied Sciences & Humanities]

First Semester

Paper No.	Code	Title	L-T-P-J	Credits
Paper-I	MMAC0001	Real Analysis	3-1-0-0	4
Paper-II	MMAC0002	Abstract Algebra	3-1-0-0	4
Paper-III	MMAC0003	Ordinary Differential Equations	3-1-0-0	4
Paper-IV	MMAC0004	Linear Algebra	3-1-0-0	4
Paper-V	MCAC0016	Programming in Python (SEC)	3-0-0-0	3
PRACTICALS				
Paper-VI	MCAC0810	Python Programming Lab (SEC)	0-0-4-0	2
				21

Second Semester

Paper No.	Code	Subject	L-T-P-J	Credits
Paper-I	MMAC 0005	Statistical Analysis	3-1-0-0	4
Paper-II	MMAC 0006	Operational Research-I	3-1-0-0	4
Paper-III	BCSC 0003/ MMAC 0007	Database Management System/ Topology	3-0-0-0/ 3-1-0-0	3/4
Paper-IV	BCSO 0007/ MMAC 0008	Data Mining for Business Analytics /Complex Analysis-I	4-0-0-0/ 3-1-0-0	4
Paper-V	MMAC 0101/ MMAC 0009	Probability and Stochastic Processes /Functional Analysis	3-1-0-0	4
Paper-VI	MELH 0006	Technical Writing (AECC)	4-0-0-0	4
PRACTICALS				
Paper-VII	MMAK 0801	Statistical Analysis Lab with R-Programming (SEC)	0-0-2-0	1
Paper- VIII	BCSC 0802	Database Management System Lab	0-0-2-0	1
				25

Third Semester

Paper No.	Code	Subject	L-T-P-J	Credits
Paper-I	MMAC 0010	**Partial Differential Equations-I**	**3-1-0-0**	**4**
Paper-II	MMAC 0011	**Operational Research-II**	**3-1-0-0**	**4**
Paper-III	BCSO 0008/ MMAC 0012	**Predictive Analytics for Data Analyst /Complex Analysis- II**	**4-0-0-0/ 3-1-0-0**	**4**
Paper-IV	BCSE 0556, BCSE 0106, MMAE 0009, MMAE 0011 BCSO0009-0012/ MMAE0001-0015	**Discipline Specific Elective I (DSE I)**	**3-0-0-0/ 3-1-0-0/ 4-0-0-0**	**3/4**
Paper-V	BCSE 0556, BCSE 0106, MMAE 0009, MMAE 0011 BCSO0009-0012/ MMAE0001-0015	**Discipline Specific Elective II (DSE II)**	**3-0-0-0/ 3-1-0-0/ 4-0-0-0**	**3/4**
Paper-VI	BELH 0006/ BCHS 0201	**Open Elective (OE I)**	**2-0-0-0**	**2**
PRACTICALS *				
***Subject to the choice of discipline specific elective (s).**				
				22*

Fourth Semester

Paper No.	Code	Subject	L-T-P-J	Credits
Paper-I	BCSE 0556, BCSE 0106, MMAE 0009, MMAE 0011 BCSO 0009-0012/ MMAE0001-0015	**Discipline Specific Elective III (DSE III)**	**3-0-0-0/ 3-1-0-0/ 4-0-0-0**	**3/4**
Paper-II	MMAC 0013	**Numerical Analysis**	**4-0-0-0**	**4**
Paper-III	BELH 0006/ BCHS 0201	**Open Elective (OE II)**	**2-0-0-0**	**2**
PROJECT				
Paper-IV	MMAJ 0961	**Dissertation (AECC)**	**0-0-0-12**	**12**
PRACTICAL *				
***Subject to the choice of discipline specific elective (s).**				
				22*

Semester	Core Courses (including SEC and AECC)			Discipline Specific Electives			Open Electives			Total Credits
	No. of Papers	Credits (L+T/P)	Total Credits	No. of Papers	Credits (L+T/P)	Total Credits	No. of Papers	Credits (L+T/P)	Total Credits	
I	5	4/3+2(P)	21	0	0	0	0	0	0	**21**
II	7	4/3+1(P)	25	0	0	0	0	0	0	**25**
III	3	4	12	2	4	8	1	2	2	**22**
IV	1	4 +12(J)	16	1	4	4	1	2	2	**22**
Total credits of the course			**74**			**12**			**4**	**90**

Core Courses © – Theory

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Real Analysis	MMAC 0001	3-1-0-0	4	40
2.	Abstract Algebra	MMAC 0002	3-1-0-0	4	40
3.	Ordinary Differential Equations	MMAC 0003	3-1-0-0	4	40
4.	Linear Algebra	MMAC 0004	3-1-0-0	4	40
5.	Statistical Analysis	MMAC 0005	3-1-0-0	4	40
6.	Operational Research-I	MMAC 0006	3-1-0-0	4	40
7.	Topology	MMAC 0007	3-1-0-0	4	40
8.	Complex Analysis-I	MMAC 0008	3-1-0-0	4	40
9.	Functional Analysis	MMAC 0009	3-1-0-0	4	40
10.	Partial Differential Equations-I	MMAC 0010	3-1-0-0	4	40
11.	Operations Research- II	MMAC 0011	3-1-0-0	4	40
12.	Complex Analysis -II	MMAC 0012	3-1-0-0	4	40
13.	Numerical Analysis	MMAC 0013	3-1-0-0	4	40
14.	Database Management System	BCSC 0003	3-0-0-0	3	30
15.	Data Mining for Business Analytics	BCSO 0007	4-0-0-0	4	40
16.	Probability and Stochastic Processes	MMAC 0101	3-1-0-0	4	40
17.	Predictive Analytics for Data Analyst	BCSO 0008	4-0-0-0	4	40

Core Courses © – Practical

S. No.	Lab Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Database Management System Lab	BCSC 0802	0-0-2-0	1	24

Discipline Specific Elective Papers: DSE (Theory)

BOUQUET (For Data Analytics)

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Hadoop and Big Data Analytics	BCSE 0556	3-0-0-0	3	30
2.	Machine Learning and its Applications	BCSE 0106	3-0-0-0	3	30
3.	Social Web and Mobile Analytics	BCSO 0009	4-0-0-0	4	40
4.	Introduction to Virtualization and Cloud Computing	BCSO 0010	4-0-0-0	4	40
5.	Digital Marketing and Transformation	BCSO 0011	4-0-0-0	4	40
6.	Data Warehouse	BCSO 0012	4-0-0-0	4	40
7.	Discrete Mathematics	MMAE 0009	4-0-0-0	4	40
8.	Optimization Techniques	MMAE 0011	4-0-0-0	4	40

Discipline Specific Elective Papers: DSE (Practical)

BOUQUET (For Data Analytics)

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Hadoop and Big Data Analytics Lab	BCSE 0585	0-0-2-0	1	20
2.	Machine Learning Lab	BCSE 0133	0-0-2-0	1	20

BOUQUET (For Mathematics)					
S. No.	**Course Name**	**Code**	**L-T-P-J**	**Credit**	**Contact Hrs.**
Bouquet 1: Relativity and Cosmology					
1.	Differential Geometry	MMAE 0001	4-0-0-0	4	40
2.	Special Relativity and Tensor Calculus	MMAE 0002	4-0-0-0	4	40
3.	General Relativity and Cosmology	MMAE 0003	4-0-0-0	4	40
Bouquet 2: Applied Mathematics					
1.	Special Functions	MMAE 0004	4-0-0-0	4	40
2.	Number Theory	MMAE 0005	4-0-0-0	4	40
3.	Partial Differential Equations -II	MMAE 0006	4-0-0-0	4	40
4.	Fluid Dynamics – I	MMAE 0007	4-0-0-0	4	40
5.	Fluid Dynamics - II	MMAE 0008	4-0-0-0	4	40
6.	Discrete Mathematics	MMAE 0009	4-0-0-0	4	40
7.	Integral Equations and Calculus of Variations	MMAE 0010	4-0-0-0	4	40
8.	Optimization Techniques	MMAE 0011	4-0-0-0	4	40
9.	Non-Linear Programming	MMAE 0012	4-0-0-0	4	40
Bouquet 3: Analysis					
1.	Operator Theory	MMAE 0013	4-0-0-0	4	40
2.	Measure Theory and Integration	MMAE 0014	4-0-0-0	4	40
3.	Fixed Point Theory	MMAE 0015	4-0-0-0	4	40

Skill Enhancement Courses (SEC)

S. No.	**Course Name**	**Code**	**L-T-P-J**	**Credit**	**Contact Hrs.**
1.	Programming in Python	MCAC 0016	3-0-0-0	3	36
2.	Programming in Python Lab	MCAC 0810	0-0-4-0	2	24
3.	Statistical Analysis Lab with R-Programming	MMAK 0801	0-0-2-0	1	20

Ability Enhancement Compulsory (AECC)

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Technical Writing	MELH 0006	**4-0-0-0**	4	40
2.	Dissertation	MMAJ 0961	**0-0-0-12**	12	---

Open Elective Courses (OE)

S. No.	Course Name	Code	L-T-P-J	Credit	Contact Hrs.
1.	Ethics and Values	BELH 0006	**2-0-0-0**	2	20
2.	Environmental Studies	BCHS 0201	**2-0-0-0**	2	20

MMAC 0001: REAL ANALYSIS

Course Objectives: To make the students understand the concepts of sequences, metric spaces, continuity, uniform continuity, uniform convergence and integration

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

Module No.	Contents	Teaching Hours (Approx.)
I	Sequences of real numbers, convergent sequence, subsequence, monotonic sequence, Cauchy sequence, limsup, liminf, Metric spaces, Limits in Metric spaces, Continuity, Types of discontinuity, Compactness, Connectedness, Uniform continuity,Sequence and Series of a function, Point-wise convergence, Uniform convergence, Cauchy criterion for uniform convergence.	20
II	Test for Uniform convergence (Weierstrass M-test, Abel's test, Dirichlet's test), Uniform convergence and integration, Uniform convergence and Differentiation, Weierstrass approximation theorem,Monotonic functions, Function of bounded variation, R-S integral, Definition and Existence of integral, Condition of integrability, Properties of integral, Fundamental theorem of calculus, Mean value theorem of integral calculus.	20

Focus: This course focuses on Employability and Skill Development aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Learn sequences of real numbers
CO2:Know continuity and uniform continuity
CO3: Understand continuity, compactness, connectedness and completeness
CO4: Determine the Riemann integrability of a function
CO5: Recognizethe difference between pointwise and uniform convergence of sequence of functions
CO6: Use tests for uniform convergence

Text Books:

- W. Rudin, Principles of Mathematical Analysis, McGraw-Hill, Kogakusha,2017.
- T.M.Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 2002.
- S. C. Malik andS. Arora, Mathematical Analysis, New Age International Ltd., 2017.
- R. Bartle, The elements of integration and Lebesgue measure, Wiley Classics Library, 1995.

Reference Books:

- K. Ross, Elementary Analysis, The Theory of Calculus, Springer Int. Edition, 2013.
- H.L.Royden, Real Analysis, Macmillan Publishing Company, New York, 2015.
- P.K.Jain and V.P.Gupta, Lebesgue Measure and Integration, New Age International, Ltd. , New Delhi, 2020.

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

COs	POs/ PSOs
CO1	PO3,PO9 /PSO1
CO2	PO1,PO3,PO9/PSO1
CO3	PO2,PO9,/PSO1,PSO3
CO4	PO4/PSO1,PSO2,PSO3
CO5	PO2/PSO1
CO6	PO5,PO6,PO12/PSO1,PSO2

MMAC 0002: ABSTRACT ALGEBRA

Course Objectives: To make the students understand the concepts of groups, rings and fields by giving more emphasis to their applications.

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

Module No.	Contents	Teaching Hours (Approx.)
I	Group theory-an introduction,Permutation groups, Direct products, Fundamental theorem of finite abelian groups,Cayley's theorem, Class equations,Sylow's theorem. Rings, Ideals, Prime and Maximal ideals, Quotient rings.	20
II	Unique factorization domain, Principal ideal domain, Euclidean domain.Polynomial rings and Irreducibility criteria.Field extensions,Algebraic and Transcendental extensions, Splitting Fields, Normal extensions, Finite fields, Construction of finite fields.	20

Focus: This course focuses on Employability and Skill Development aligned with all CO's

Learning Outcomes:

After studying these topics, the students will be able to

CO1: Know various groups and their subgroups
CO2: Understand the direct product of groups and its applications
CO3: Learn the properties of rings, ideals and fields
CO4: Find the field and normal extensions
CO5: Construct finite fields

Text Books:

- P. B. Bhattacharya, S. K. Jain and S. R.Nagpaul, Basic abstract algebra, Cambridge University Press, 1994.
- J. A. Gallian, Contemporary Abstract Algebra, Brooks/Cole, Cengage Learning, 2010.
- V. K. Khanna andS. K. Bhamri, A Course in Abstract Algebra, Vikas Publishing House, 2016.

Reference Books:

- I. N. Herstein, Topics in Algebra, John Wiley & Sons, 2006.
- D. S. Dummit and R. M. Foote, Abstract Algebra,Wiley, 2003.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO6, PO8, PO11, PO12 / PSO1, PSO2, PSO 4
CO2	PO1, PO5, PO8, PO9, PO11 / PSO1, PSO2, PSO4
CO3	PO1, PO2, PO3, PO4, PO7,PO9, PO10, PO12 / PSO1, PSO3, PSO4
CO4	PO2, PO4, PO5, PO7, PO10 / PSO2, PSO3
CO5	PO2, PO3, PO8, PO10, PO12 / PSO1, PSO3

MMAC 0003: ORDINARY DIFFERENTIAL EQUATIONS

Course Objectives: To make the students understand the concepts of initial value and boundary value problems and their application to find the stability of dynamical systems.

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

Module No.	Contents	Teaching Hours (Approx.)
I	Introduction, Initial and Boundary value problems,Existence and Uniqueness of solutions ofordinary differential equationof first order,Lipschitz condition,Picard's method, Existence and Uniqueness theorem for ordinary differential equation of higher order, Strum-Liouville boundary value problem, Orthogonal sets of function, Eigen values and Eigen functions, Eigen function expansions, Separation and Comparison theorems.	20
II	Green's functions, Construction of Green's function and its application to solve the boundary value problems, Stability of autonomous system of differential equations, Critical point of an autonomous system and their classification as stable, asymptotically stable and strictly stable. Stability of linear system with constant coefficient, Linear plane autonomous system, Perturbed system, Method of Lyapunov for non-linear systems.	20

Focus: This course focuses on Employability and Skill Development aligned with CO1 and CO2

Course Outcomes:

After studying these topics, the student will be able to

CO1: Apply initial and boundary values to find particular solutions to first-order, second-order and higher order homogeneous and non-homogeneous differential equations

CO2: Use Green's function for the solution of boundary value problems

CO3: Find the stability of linear and non-linear dynamical systems.

CO4: Know the Eigen values and Eigen functions.

Text Books:

- M.D.Raisinghania, Ordinary Differential Equations, S.Chand & Co., 2019.
- Sharma and Gupta, Differential Equations, Krishna Educational Publishers, 2015.
- E.A. Coddington and N. Levinson,Theory of Ordinary Differential Equations, McGraw Hill, NY, 2017.

Reference Books:

- G. Birkhoff and G.C. Rota, Ordinary Differential Equations, John Wiley and Sons Inc..NY, 1989.
- S.L. Ross, Differential Equations, John Wiley and Sons Inc., NY, 1984.
- W.E. Boyce and R.C. Di Prima, Elementary Differential Equations and Boundary value Problems, John Wiley and Sons Inc., NY, 2009.
- P. Hartman, Ordinary Differential Equations, John Wiley & Sons, NY-L-Sydney, 1982.

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

COs	POs/ PSOs
CO1	PO1,PO3,PO5,PO8,PO10,PO12 / PSO1, PSO4
CO2	PO2, PO3, PO4, PO7, PO10, PO11 / PSO 2, PSO4
CO3	PO2, PO6. PO9, PO11, PO12 / PSO 1, PSO2
CO4	PO1, PO4, PO5, PO7, PO12, / PSO 1, PSO3

MMAC 0004: LINEAR ALGEBRA

Course Objectives: To make the students understand the concepts of vector spaces, linear transformations, diagonalizability, Gram-Schmidt orthogonalization process,Jordan, rational and bilinear forms by giving more emphasis to their applications.

L–T–P-J: 3–1–0-0

Credits: 04 **Semester I**

Module No.	Contents	Teaching Hours (Approx.)
I	Vector space, Subspace, Basis and Dimension of a vector space,Linear transformations, Matrix representation of a linear transformation, Kernel and Range of a linear transformation, Rank and nullity theorem, Characteristic values and Characteristic vectors of linear transformations, Diagonalizability, Minimal polynomial of a linear transformation, Cayley Hamilton theorem.	20
II	Invariant subspaces, Direct sum decompositions, Invariant direct sums, The primary decomposition theorem, Inner product spaces,Gram-Schmidt orthogonalization process, Orthogonal complements, Gram-Schmidt Theorem, Bilinear forms: symmetric and skew symmetric, Rational and Jordan forms.	20

Focus: This course focuses on Employability and Skill Development aligned with all CO's

Course Outcomes:

After studying these topics,the students will be able to

CO1: Understand vector spaces and their subspaces
CO2: Find rank and nullity of a linear transformation
CO3: Calculate characteristic and minimal polynomials
CO4: Find orthogonal vectors using Gram-Schmidt orthogonalization process
CO5: Know rational and Jordan forms for a given matrix
CO6: Learn bilinear forms and their applications

Text Books:

- K. Hofmann and R. Kunze, Linear Algebra. Prentice Hall of India, New Delhi,2015.
- S. H. Friedberg, A. J. Insel and L. E. Spence, Linear Algebra, PHI Learning Pvt. Ltd., New Delhi, 2015.
- Schaum's Outline, Linear Algebra, McGraw Hill Education, Pvt. Ltd., 2017.

Reference Books:

- B. Kolman and D.R. Hill, Elementary Linear Algebra with Applications, Pearson Education, 2019.
- S. Andrilli and D. Hecker, Elementary Linear Algebra, Academic Press, 2019.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO6, PO8, PO11, PO12 / PSO1, PSO2, PSO 4
CO2	PO1, PO5, PO8, PO9, PO11 / PSO1, PSO2, PSO4
CO3	PO1, PO2, PO3, PO4, PO7,PO9, PO10, PO12 / PSO1, PSO3, PSO4
CO4	PO2, PO4, PO5, PO7, PO10 / PSO2, PSO3
CO5	PO2, PO3, PO8, PO10, PO12 / PSO1, PSO3
CO6	PO1, PO3, PO6, PO7, PO11 / PSO1, PSO3, PSO4

MCAC0016: PROGRAMMING IN PYTHON

Course Objectives: To make the students understand the concepts of sequences, metric spaces, continuity, uniform continuity, uniform convergence and integration

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Introduction to Pytho**n: 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. **Functions:** Defining & Calling a function, Passing arguments to functions – Mutable & Immutable Data Types, Different types of arguments, Recursion, Scope of variables.	20
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.	20

Focus: This course focuses on Skill Development aligned with CO5

Course Outcomes:

After studying these topics, the students will be able to

- **CO1:** Understand to solve problems with smaller Lines of Code using Python as compared to other programming languages
- **CO2:** Use OO concepts while programming in Python
- **CO3:** Use in-built packages defined in Python
- **CO4:** Work with Python using GUI
- **CO5:** Develop skills to make new packages while programming in Python

Text Book:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2016.

Reference Book:

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

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

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO8, PO9,PO10 / PSO1, PSO2, PSO4
CO2	PO1, PO2, PO5, PO7, PO8, PO11, PO12 / PSO1, PSO2, PSO3
CO3	PO3, PO5, PO7, PO10, PO11 / PSO1, PSO2, PSO3, PSO4
CO4	PO2, PO3, PO4, PO7, PO9 / PO12, PSO1, PSO3, PSO4
CO5	PO12/PSO3

MCAC0810: PROGRAMMING IN PYTHON LAB

Credits: 02 **Semester I** **L–T–P: 4–0–0**

Module No.	Contents	Lab Hours (Approx.)
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	24

Focus: This course focuses on Skill Development aligned with CO5

Course outcomes:

After studying these topics, the students will be able to

CO1: Solve problems with smaller Lines of Code using Python
CO2: Use OO concepts while programming in Python
CO3: Understand in-built packages defined in Python
CO4: Learn front-end as Python Programming to connect with any back-end
CO5: Develop programming skills in Python

Text Books:

- Paul Barry: “Head First Python “O’Reilly Media, Inc.", 2016.

Reference Books:

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

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 / PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO5, PO9 / PSO1, PSO2, PSO3
CO4	PO1, PO2, PO3, PO5, PO9/ PSO1, PSO3
CO5	PO12/PSO3

MMAC 0005: STATISTICAL ANALYSIS

Course Objectives: To make the students understand the concepts of statistical analysis, probability distributions, testing of hypothesis, correlation and regression analysis and their applications.

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

Module No.	Content	Teaching Hours (Approx.)
I	**Introduction to Statistical Analysis**: What is statistics? Types of Statistics, Population vs Sample, basic terminology, Measurement & Scaling: characteristics **Types of 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 Quartile Deviation:** Measures of position-quartiles and interquartile range, Quartiles, Percentiles. **Data representation and Simple Probability:** Graphical presentation of qualitative data, Graphical quantitative data, Frequency distributions, relative frequency and percentage distributions, Cumulative frequency distributions, Probability concepts, Simple and compound events, Classical probability, Complementary events, Discrete Random Variables. **Probability Distributions:** Binomial, Poisson and Normal Distribution.	20
II	**Correlation and Regression Analysis:** Covariance, Pearson correlation coefficient, Computing a correlation, Correlation coefficient, correlation analysis, Scatter plots, Extreme data values, Correlation Matrix, ANOVA, Regression. **Testing Hypothesis I:** Population distribution, Sampling and Non sampling Errors, point estimate, Interval estimation, The t Distribution, Testing Hypothesis, Chi-Square Distribution, The F-Distribution **Testing Hypothesis II:** Non Parametric tests, Chi-squared goodness-of-fit test, Chi-square test of independence,	20

Focus: This course focuses on Employability and Skill Development aligned with all CO's

Course Outcomes:

By the completion of this course, students will learn to:

- **CO1:** Concept of various statistical methods which can be applied on data analysis and other real problems;
- **CO2:** Applying the methods to actual quantitative data and interpreting the results of the analysis.
- **CO3:** Know the probability distributions and apply on real data problems
- **CO4:** Applying the testing of hypothesis on various problems

Text Books:

- S. C. Gupta & V. K. Kapoor Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2014.
- G. Jay Kerns, Introduction to Probability and Statistics Using R, G. Jay Kerns, 2014.

Reference Books:

- D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley India, 2013.

- A. M. Mood, F. A. Graybill and D. C. Boes, Introduction to the Theory of Statistics, Tata McGraw-Hill, 2017.
- H.A. David and H.N.Nagaraja, Order Statistics, John Wiley & Sons, 2003.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO10, PO11, PO12/ PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PO5,PO10, PO11, PO12 / PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO5,PO10, PO11, PO12 / PSO1, PSO3
CO4	PO1, PO2, PO3, PO4, PO5,PO10, PO11, PO12 / PSO1, PSO2, PSO3

MMAC 0006: OPERATIONAL RESEARCH-I

Course Objectives: To make the students understand the concepts of quantitative techniques for effective decision making, model formulation and their applications

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Linear Programming Problems (LPP):**The origin of OR, Definition and scope of Operation Research, Classification of OR models, Formulation of Linear-programming model, graphical solution, Simplex method. Big-M method, two-phase method, Duality, Dual Simplex method, Sensitivity Analysis. **Integer Linear Programming Problems:**Integer Programming Problems, Mixed Integer Programming Problems, Cutting Plane Method, Branch and Bound Method. **Assignment:**Assignment problem and its mathematical formulation, solution of assignment problem (Hungarian method).	20
II	**Transportation Problems:** Transportation problem and its mathematical formulation. Initial basic feasible solution of transportation problem by North-West corner rule, Lowest-Cost Entry method and Vogel's Approximation method, optimal solution of transportation problem. **CPM and PERT:** Network Diagram-Events and Activities- Project Planning Reducing Critical Events and Activities-Critical Path Calculations-Examples- Resources and Man Power Leveling. Sequencing Problems-Travelling Salesman Problems –Machine Scheduling Problem (Job-Shop). **Non Linear Programming:** Formulation of an NLPP, Concave and Convex Functions, Solution of NLPP, Having more than one in Equality Constraint using Kuhn-Tucker Condition.	20

Focus: This course focuses on Employability and Skill Development aligned with CO3 and CO4

Course Outcomes:

After studying these topics, the student will be able to

CO1: Solve various linear programming problems
CO2: Construct operation research models from the description of the real systems
CO3: Learn the mathematical tools to solve various optimization problems
CO4: Understand the theoretical working of different methods of operation research

Text Books:

- P. K. Gupta and D. S. Hira, Operations Research, S. Chand & Co., Delhi, 2015.
- J. K. Sharma, Operations Research Theory and Applications, Macmillian India Ltd., New Delhi, 2017.
- K. Swarup, P. K. Gupta and M. Mohan, Operations Research, Sultan Chand & Sons, 2014.

Reference Books:

- S. D. Sharma, Operations research, Kedar Nath & Ram Nath Publications, Meerut, 2012.
- H. A. Taha, Operations research: An introduction, Pearson Education, New Jersey, 2014.

- D. C. Sanyal and K. Das, Linear programming and Game Theory, U. N. Dhur& Sons Pvt. Ltd., 2020.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO11, PO12/ PSO1, PSO2, PSO3
CO2	PO1, PO2, PO4, PO5,PO10, PO11, PO12 / PSO1, PSO2, PSO3
CO3	PO1, PO2, PO4, PO6, PO11, PO12 / PSO1, PSO2, PSO3
CO4	PO2, PO3, PO4, PO6, PO10, PO12 / PSO1, PSO2, PSO3

MMAC 0007: TOPOLOGY

Course Objectives: To make the students understand the concepts of topological spaces, continuous functions, connected, compact and countability axioms and separation axioms.

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

Module No.	Contents	Teaching Hours (Approx.)
I	Topological spaces, Basis and Sub basis, Ordered topology, Limit points, Adherent points, Isolated points, Derived sets, Dense sets, Closure, Interior, Exterior and Boundary pointsof a set, Subspaces, Continuity andRelated results, The Pasting lemma. Homeomorphism, Product topology, Product of topological spaces, Metric topology, Metrizable space,Quotient topology.	20
II	Connected and Disconnected spaces, Components, Path connected spaces, Path components, Totally disconnected spaces, Locally connected spaces. Compact spaces, Limit point compact and sequentially compact spaces, Local compactness, First and Second countable spaces, Separable space, Separation axioms: T_0,T_1, T_2, T_3, $T_{3^{1/2}}$, T_4 spaces, Characterizations and basic properties.	20

Focus: This course focuses on Employability and Skill Development aligned with CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Understand topology, topological spaces and topology generated by basis and sub basis

CO2: Determine the nature of different points of a set

CO3: Characterizethe connected and compact spaces

CO4: Know separation axioms and basic properties

Text Books:

- J. R. Munkres, Topology, a first course, Prentice-Hall of India Ltd., New Delhi, 2000.
- G. F. Simmons, Introduction to topology and modern analysis, Tata McGraw Hill, 1963.
- J. N. Sharma and J. P. Chauhan, Topology (General and Algebraic), Krishna Prakashan, 2019.

Reference Books:

- J. L. Kelley, General topology, Springer Verlag, New York, 2017.
- K. D. Joshi, An introduction to general topology, Wiley Eastern Ltd., New Delhi, 2017.

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

COs	POs/ PSOs
CO1	PO1, PO6, PO9, PO11/ PSO1, PSO2, PSO4
CO2	PO1, PO2, PO3, PO6, PO9 / PSO1, PSO2, PSO3
CO3	PO1, PO2, PO3, PO5, PO11 / PSO1, PSO2, PSO4
CO4	PO1, PO2, PO6, PO5, PO9/ PSO1, PSO2, PSO4

MMAC 0008: COMPLEX ANALYSIS- I

Course Objectives: To develop in a rigorous and self-contained manner the elements of complex variables and to furnish an introduction to application of residues.

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

Module No.	Contents	Teaching Hours (Approx.)
I	Introduction, Complex integration, Contour, Simply and multiply connected regions, Cauchy-Goursat theorem, Cauchy's integral formula, Higher order derivatives, Morera's theorem, Cauchy's inequality, Liouville's theorem, Fundamental theorem of algebra, Poisson's integral formula, Maximum modulus principle, Minimum modulus principle, Rouche's theorem.	20
II	Power series, Radius of convergence, Expansion of analytic functions as power series, Taylor's and Laurent's Theorem, Schwarz Lemma, Zeros of an analytic function, Isolated singularities, Limit point of zeros and poles, Meromorphic functions, The argument principle, Inverse mapping theorem, Calculus of residues, Cauchy's residue theorem and its application in evaluation of integrals.	20

Focus: This course focuses on Employability and Skill Development aligned with CO2 and CO4

Course Outcomes:

After studying these topics, the student will be able to

CO1: Use the information needed to prove theorems and establish mathematical results

CO2: Demonstrate the ability to integrate knowledge and ideas of complex differentiation and complex integration in a coherent and meaningful manner and use appropriate techniques

CO3: Develop the ability to think critically by proving mathematical conjectures and establishing theorems from complex analysis

CO4: Determine the region of convergence for the possible expansion of function

Text Books:

- V. Ruel Churchill and J. W. Brown, Complex Variables and Applications, McGraw-Hill Publishing Company, 2017.
- S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 2011.
- H. A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 2008.
- J. B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 2000.

Reference Books:

- S. Lang, Complex Analysis, Addison Wesley, 1988.
- M. J. Ablowitz and A. S. Fokas, Complex Variables: Introduction and Applications, Cambridge University Press, South Asian Edition, 2003.
- Rudin, Real and Complex Analysis, Mc Graw Hill, 2017.

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

COs	POs/ PSOs
CO1	PO1, PO4, PO6, PO10, PO11/ PSO1, PSO2, PSO4
CO2	PO1, PO2, PO3, PO4, PO6, PO9, PO10, PO11, PO12 / PSO1, PSO2, PSO4
CO3	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11, PO12 / PSO1, PSO2, PSO3, PSO4
CO4	PO1, PO2, PO3, PO4, PO10, PO11, PO12/ PSO1, PSO2, PSO4

MMAC 0009: FUNCTIONAL ANALYSIS

Course Objectives: To make the students understand the concepts of bounded operators between normed linear spaces, Banach spaces, Hilbert spaces andtheir properties.

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

Module No.	Contents	Teaching Hours (Approx.)
I	Normed linear spaces, Banach spaces, Hilbert Spaces and basic properties, Heine Borel theorem, Rieszlemma and best approximation property,Inner product spaces, Projection Theorem,Bounded operators, Space of bounded operators, unbounded operators, Riesz representation theorem,Convergence of sequence of operators, Closed operator	20
II	Orthonormal bases, Bassel inequality and Parseval's Formula, Riesz Fischer theorem,Hahn Banach extension theorem, Uniform boundedness principle, Closed graph theorem and Open mapping theorem, Applications.	20

Focus: This course focuses on Employability and Skill Development aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Understand Banach spaces and Hilbert spaces
CO2: Learn bounded operators and their properties
CO3: Find orthonormal basis
CO4: Use projection theorem
CO5: Know the applications of closed graph theorem and open mapping theorem

Text Book:

- M. T. Nair, Functional Analysis, A first course, Prentice Hall of India, 2001.
- B. V. Limaye, Functional Analysis, New Age International, 2014.

Reference Books:

- E. Kreyazig, Introductory Functional Analysis with Applications, John Wiley and Sons, New York, 2007.
- Bollobas, Linear Analysis: An Introductory Course, Cambridge University Press, 1999.
- A .E. Taylor and D. C. Lay, Introduction to Functional analysis, Wiley, New York, 1980.
- G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, Inc. 2017.
- A.H. Siddiqi, K. Ahmad and P. Manchanda, Introduction to Functional Analysis with Applications, Anamaya Publishers, New Delhi, 2007.

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

COs	POs/ PSOs
CO1	PO1, PO4, PO10, PO11/ PSO1, PSO4
CO2	PO2, PO3, PO4, PO9, PO12/ PSO2, PSO4
CO3	PO3, PO4, PO10, PO11, PO12 / PSO1, PSO2, PSO4
CO4	PO3,PO4,PO10,PO11,PO12/PSO1,PSO2,PSO4
CO5	PO1, PO2, PO3, PO4 PO6, PO10/ PSO1, PSO2, PSO3, PSO4

MELH0006: TECHNICAL WRITING

Course Objectives: To make the students understand the concepts ofvarious modes of written communication used to disseminate information within and outside an organization.

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	Forms & features of communication factors facilitating communication-communication channels, Flow of communication, Language skills-LSRW, Barriers to communication, Words and Phrases, Sentences and Paragraphs, Art of condensation reading comprehension, Analyzing audience, Organizing contents, Preparing an outline, Visual aids paragraph writing characteristics and methods Technical reports, Importance, Preparatory steps and Structure letters, Memos and E-mails- structure, Principles, Types.	20
II	Technical proposals- Definition, Types, Structure and Style. Journal articles/ Research papers- Nature, Significance and essentials. Job Application- Resume, Curriculum Vitae and Cover letter. Interviews-Types, Preparation, Success and Failure Factors. Agenda and minutes of a meeting. Note making & summarizingDissertation and Thesis- Definition, Characteristics Style and Presentation. Preparing List of References and Bibliography: Referencing Conventions	20

Focus: This course focuses on Skill Development aligned with CO3 and CO4

Course Outcomes:

After studying these topics, the student will be able to

CO1: Understand communication features

CO2: Learn writing skills to write technical reports, formal messages and letters

CO3: Know the writing of technical proposals, research papers, dissertation reports etc.

CO4: Make curriculum vitae, resume and agenda and minutes of a meeting

Text Books:

- R. Meenakshi and S. Sharma, Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2015.

Reference Books:

- M. A.Rizvi, Effective Technical Communication, New Delhi, Tata McGraw Hill, 2017.
- R. C.Sharma and K. Mohan, Business Correspondence and Report Writing, Tata McGraw Hill, New Delhi, 2017.

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

COs	POs
CO1	PO7, PO8, PO9, PO10/ PSO4
CO2	PO7, PO8, PO9, PO10/ PSO4
CO3	PO7, PO8, PO9, PO10/ PSO4
CO4	PO7, PO8, PO9, PO10

MMAK 0801: Statistical Analysis Lab with R-Programming

Course Objectives: 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.

Credits: 01 **Semester II** **L–T–P: 0–0–2**

Module No.	Contents	Lab Hours
I	• Introduction and Basics of R • Introduction to Data frames in R • Merging and Importing Data in R • Handing Numerical and categorical variables • Data manipulation in R • Data Preprocessing in R • Plotting of Histogram and Pie chart • Plotting Bar charts and Scatter plot • Probability Distribution in R • Statistical tests in R • Correlation & Regression	20

Focus: This course focuses on Skill Development aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Use R Studio, read R documentation, and write R scripts.

CO2: Import, export and manipulate data.

CO3: Produce statistical summaries of continuous and categorical data.

CO4: Produce basic graphics using standard functions, and produce more advanced graphics using the lattice and ggplot2 packages.

CO5: Perform common hypothesis tests, and run simple regression models in R

CO6: Produce reports of statistical analyses in R Markdown

Text Books:

- P. Teetor and R Cookbook, Proven recipes for data analysis, statistics, and graphics, O'Reilly Media, Inc., 2011.
- N. Matloff, The art of R programming: A tour of statistical software design, No Starch Press, 2011.

Reference Books:

- W. Chang, R graphics cookbook, O'Reilly Media, Inc., 2018.
- H. Wickham and G. Grolemund, R for data science, 2016.
- P. Spector, Data manipulation with R, Springer Science and Business Media, 2008

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

COs	POs/ PSOs
CO1	PSO1, PO-2
CO2	PSO1, PO3,PO4, PO12
CO3	PSO2, PO1,PO2, PO12
CO4	PSO1, PO1,PO5
CO5	PSO1, PO5, PO12
CO6	PSO3, PO12

COURSES OFFERED

(w.e.f. Session 2020-21)

DEPARMENT OF MATHEMATICS

BMAS 1101: ENGINEERING MATHEMATICS I

Course Objectives: To make the students understand the concepts of convergence of infinite series, differentialcalculus, integral calculus and vector calculus by giving more emphasis to their applications in engineering.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Convergence of Infinite Series:** Introduction, Limit u_n test, Leibnitz test, p-series test, Comparison test, Cauchy's root test, Ratio test. **Differential Calculus**: Introduction, Partial derivatives, Euler's theorem for homogeneous functions, Composite functions, Expansion of functions of several variables, Jacobian and its properties.	20
II	**Integral Calculus**: Introduction, Beta and Gamma functions, Evaluation of double integrals in cartesian and polar coordinates, Evaluation of triple integrals,Change of variables in solving double integrals. **Vector Calculus:** Introduction, Gradient of a scalar point function, Divergence and Curl of a vector point function,Line Integral, Green's theorem.	20

Focus: This course focuses on Skill Development aligned with CO's

Course Outcomes:

After studying these topics, the student will be able to

CO1: Apply different tests for determining convergence of an infinite series
CO2: Understand partial differentiation and its applications
CO3: Evaluate double and triple integrals and study their applications
CO4: Learn to use change of variables in solving double integrals
CO5: Find the gradient of a scalar field and divergence, curl of a vector field
CO6: Know line integral and its applications

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publications, Delhi, 2014.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.
- H. Kishan, Sure Success in Convergence, Atlantic Publishers & Dist., Delhi, 2005.

Reference Books:

- T. M. Apostol, Calculus, Volume I, John Wiley & Sons, Inc., USA, 1967.
- T. M. Apostol, Calculus, Volume II, Xerox Corporation, USA, 1969.
- G. B. Thomas and R. Finney, Calculus & Analytic geometry, Addison Wesley, USA, 1995.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, New Delhi, 2002.

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, PO3
CO4	PO1, PO2, PO3, PO4
CO5	PO1, PO2
CO6	PO1, PO2, PO3, PO6

BFBC 0002: QUANTITATIVE ASPECTS OF BUSINESS

Introduction: *The course will enable the students in terms of understanding the quantitative aspects related to business thereby enhancing their skills.*

Objective: *Studying this subject would improve the mathematical abilities and statistical skills of the students and help them in understanding related concepts.*

Credits: 04 **Semester I** **L–T–P-J: 3–2–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Matrices**: Addition, Subtraction, Multiplication of matrices, Inverse of matrices, Systems of linear equations and its applications. Differentiation of functions of single variable (excluding trigonometric functions), Breakeven analysis, Simple problems of maxima and minima. Role of Statistics in Business, Classification & presentation of data with the help of MS-Excel. Application of measures of central tendency –Mean, Mode, Median. Measures of dispersion, Range, Quartile Deviation, Standard deviation in business decision making.	20
II	Correlation – Karl Pearson's Correlation – Rank Correlation. Regression- Fitting regression equations, Uses of Regression in Business Problems. **Time Series-** Components of time Series – Measurement of Trend – Semi Average method – Moving Average method – Method of Least Squares – Measurement of Seasonal Variations – Simple Average Method – Ratio to Moving Average Method. Index Numbers – Un weighted Index Numbers, weighted Index Numbers: Laspeyre's, Paasche, Fisher, Bowley's and Marshall–Edgeworth's method, Cost of Living Index Number–Test on index numbers. MS-excel based application to address the issues of Time series.	20

Reference Books/ Text Books/ Cases:

- Sharma, J. K. (2010), Business Mathematics, New Delhi: Ane Books (P) Ltd.
- Bajpai, N. (2001). Business Statistics. New Delhi: Pearson Education (P) Ltd.
- Levin, R. I. (1997), Statistics for Management. New Delhi: Pearson Education (P) Ltd.
- Beri, G. C. (2010). Business Statistics. New Delhi: Tata McGraw Hill Publishing Company Ltd.
- Gupta, S. C. (2006). Fundamentals of Statistics. New Delhi: Himalaya Publishing House

Intended Outcomes: *After completion of the course, student will be able to:*

- Understand the basic concepts of business statistics.
- Interpret and solve real-life business problem using the concepts of statistics.
- Understand the business & industry problems along with working o*ut their solutions.*
- Understand the business & industry problems along with working out their solutions.
- Understand various mathematical concepts use*ful in day-to-day scenario.*

BMAS 0151: MATHEMATICS I

Course Objectives: To make the students understand the concepts of algebra, calculus, differential equations and probability.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Algebra:** Introduction to matrices, Types, Operations, Minors and Co-factors, Properties of determinant, Adjoint and Inverse of a matrix, Cramer's rule, Elementary row operations, Rank of matrix by Echelon form, Solution of a system of simultaneous linear equations. **Calculus**: Concept of limit, Methods of finding derivatives & integrals (simple problems), Maxima & Minima for the functions of one variable.	20
II	Expansion of functions of one variable by Taylor & Maclaurin series, Indeterminate forms, L' Hospital rule. **Ordinary Differential Equations:** Introduction, Variable separable, Linear & Bernoulli forms, n^{th} order linear differential equations with constant coefficients, Complementary function and Particular integral. **Probability**: Introduction to probability, Additive and Multiplicative laws of probability (simple problems).	20

Course Outcomes:

After studying these topics, the student will be able to

CO1: Grasp the applications of matrices and determinant
CO2: Find rank of a matrix & its applications in solving systems of linear equations
CO3: Understand the concepts of elementary differentiation and integration
CO4: Solve the differential equations of first and higher orders
CO5: Know the basic concepts of probability

Text Book:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publications, Delhi, 2014.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.
- C. Prasad, Mathematics for Engineers, Prasad Mudranalaya, Allahabad, 1978.

Reference Book:

- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, New Delhi, 2002.
- E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Singapore, 2006.

BMAS 0152: MATHEMATICS II

Course Objectives: To make the students understand the concept of statistics, probability distributions and numerical methods.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Statistics**: Importance & Limitations of Statistics, Measures of central tendency & Dispersion, Merits and Demerits. **Probability Distributions**: Binomial, Poisson and Normal distributions, Simple applications. **Statistical Methods**: Moments, Skewness and Kurtosis by the method of moments.	20
II	Correlation, Lines of regression, Sampling, Level of significance, Chi-Square test as a goodness of fit and as a test of independence. **Numerical Methods**: Newton Raphson method and its Order of convergence, Finite differences, Relation between operators, Missing term technique, Newton's interpolation formulae, Newton's divided difference formula, Newton–Cote's formula, Trapezoidal and Simpson's rules, Runge–Kutta IV order formula.	20

Course Outcomes:

After studying these topics, the student will be able to

CO1: Understand the concepts of Statistics
CO2: Apply numerical methods
CO3: Use probability distributions
CO4: Measure correlation between two variables

Text Books:

- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- M. Goyal, Computer Based Numerical & Statistical Techniques, Laxmi Pub., New Delhi, 2015.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Statistics, Sultan Chand & Sons, Delhi, 2014.
- P. Gupta, Comprehensive Business Statistics, Laxmi Publications, Delhi, 2011.

Reference Books:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Delhi, 2014.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, New Delhi, 2002.
- J. K. Sharma, Business Statistics, Pearson Education, Delhi, 2012.

BMAS 0153: OPTIMIZATION METHODS

Course Objectives: To make the students understand the concept of linear programming, transportation and assignment problems, sequencing, network analysis and inventory control.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Linear Programming Problem:** Construction of LPP, Feasible and Basic feasible solutions, Optimal solution, Unbounded solution, Infeasible solution, Infinite solutions, Graphical method. **Transportation Problem**: Introduction, Basic feasible solution by North West Corner rule, Row Minima method, Column Minima method, Least Cost method, VAM, Optimal solution by MODI method, Degeneracy. **Assignment Problem**: Introduction, Hungarian method (Balanced and Unbalanced).	20
II	**Sequencing:** Introduction, Johnson's rule, Problems with n jobs and k machines, Total elapsed time, Problems with 2 jobs and k machines (Graphical solution). **Network Analysis:** Introduction, Rules and guidelines for drawing network, Fulkerson's rule, Dummy activity, CPM and Concept of float, PERT and Concept of slack. **Inventory Control:** Introduction, Types of inventory, Inventory decisions, Economic order quantity, Deterministic inventory problems, EOQ problems with price breaks.	20

Course Outcomes:

After studying these topics, the student will be able to

CO1: Describe at an intuitive level the process of artificial intelligence and operations research: a real-time cycle of problem understanding, formulation, solution and implementation

CO2: Formulate simple reasoning, learning and optimization problems, in terms of the representations and methods presented

CO3: Solve deterministic inventory problems

CO4: Know the concepts of CPM and PERT

Text Book:

- P. K. Gupta and D. S. Hira, Operations research, S. Chand & Co. Ltd., Delhi, 2014.

Reference Books:

- (Col.) G. S. Cheema, Operations Research, Laxmi Publications Pvt. Ltd, 2011.
- V. K. Kapoor, Operations research, Sultan Chand & Sons, Delhi, 2014.
- S. D. Sharma, Operations research, Kedar Nath & Ram Nath Publications, Meerut, 2008.
- H. A. Taha, Operations research: An introduction, Pearson Education, New Jersey, 2003.

BMAS 0201: BUSINESS MATHEMATICS

Course Objectives: To make the students understand the concepts of basic algebra, quantitative aptitude, matrices and mathematics of finance.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Basic Algebra:** Introduction, Representation of sets, Types & Basic operations on set, Laws of set algebra, Venn diagram, Use of set theory in business, Linear & Quadratic equations in one variable, Introduction to Permutation and Combination (Simple problems). **Quantitative Aptitude:** Time & Distance, Time & Work, Boats & Streams, Pipes & Cisterns, Partnership, Percentage.	20
II	Profit and Loss, Problems on ages, Problems on trains, Surds, Indices & Logarithms. **Mathematics of Finance:** Ratio & Proportion, Simple and Compound interest, Profit and Loss, Annuity. **Matrices:** Definition, Types of matrices, Operations on matrices, Transpose, Adjoint & Inverse of matrix, Determinants, Solution of system of equations by Cramer's rule, Use of matrix in business.	20

Course Outcomes:

After studying these topics, the student will be able to

CO1: Understand the basic concepts of Business Mathematics

CO2: Develop basic skills for quantitative application in business situations

CO3: Interpret and solve real-life business problems using such concepts as differentiation

CO4: Understand concepts as matrices and other various mathematical concepts useful in day-to-day scenario

Text Books:

- D. C. Sancheti and V. K. Kapoor, Business Mathematics, Sultan Chand & Company, Delhi, 2014.
- J. K. Sharma, Business Mathematics, Theory and Applications, Ane Books, Delhi, 2009.

Reference Books:

- P. Gupta and O. P. Chug, Comprehensive Business Mathematics, Laxmi Pub., Delhi, 2008.
- Q. Zameeruddin, V. K. Khanna and S. K. Bhambhari, Business Mathematics, Vikas Pub., Delhi, 2009.

BMAS 0202: BUSINESS STATISTICS

Course Objectives: To make the students understand the concept of statistics and index number.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Statistical Data Presentation:** Meaning, Importance and Limitations of Statistics, Types of data, Frequency distributions, Diagrammatic & Graphical representation. **Statistical Average**: Requisite of a good average, Measures of Central tendency & Dispersion, Merits and Demerits. **Moments:** Computation of moments, Skewness & Kurtosis by the method of moments.	20
II	**Index Number:** Introduction, Types, Construction of index numbers, Methods of determining index number, Tests, Cost of living index number. **Correlation & Regression**: Introduction, Correlation between two variables, Karl Pearson's method, Rank correlation, Lines of regression, Simple applications. **Probability**: Additive and Multiplicative laws of probability, Binomial & Poisson distributions, Simple applications.	20

Course Outcomes:

After completion of the course, student will be able to

CO1: Understand the basic concepts of business statistics
CO2: Interpret and solve real-life business problems using concepts of statistics
CO3: Understand and solve problems of regression and correlation
CO4: Understand and solve problems of probability

Text Books:

- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- P. Gupta, Comprehensive Business Statistics, Laxmi Publication, Delhi, 2011.

Reference Books:

- J. K. Sharma, Business Statistics, Pearson Education, Delhi, 2012.
- R. I. Levin and D. Rubin, Statistics for Management, PHI, Delhi, 1994.

BCLC 0005: BUSINESS STATISTICS

Course Objectives: To develop the student's ability to deal with numerical and quantitative issues in business. To enable the use of statistical, graphical and algebraic techniques wherever relevant. To have a proper understanding of Statistical applications in Economics and Management.

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

Module No.	Contents	Teaching Hours (Approx.)
I	Concept, significance & Limitation Type of Data, Classification & Tabulation, Frequency Distribution & graphical representation. Measures of Central Tendency (Mean, Medium, Mode) Measures of Variation: Significance & Prosperities of a good measure of variation: Range, Quartile Deviation, Mean Deviation and Standard Deviation, Measures of Skewness & Kurtosis. Significance of Correlation, Types of correlation, Simple correlation, Scatter Diagram method, Karl Pearson Coefficient of Correlation.	24
II	Regression: Introduction, Regression lines, and Regression Equation & Regression coefficient. Probability: Concept, Events, Addition Law, Conditional Probability, Multiplication Law & Bayes' theorem [Simple numerical], Probability Distribution: Binomial, Poisson and Normal. Sampling Method of sampling, Sampling and Non-sampling errors. Test of Hypothesis, Type- I and Type –II Errors, Large sample tests.	24

Course Outcomes:

After studying these topics, the student will be able to

CO1: Describe and discuss the key terminology, concepts tools and techniques used in business statistical analysis.

CO2: Critically evaluate the underlying assumptions of analysis tools.

CO3: Understand and critically discuss the issues surrounding sampling and significance.

CO4: Discuss critically the uses and limitations of statistical analysis.

CO5: Solve a range of problems using the techniques covered.

CO6: Conduct basic statistical analysis of data.

Reference Books:

1. Business Statistics by R. S. Bharadwaj, pub: Excel Book
2. Business Statistics by Richard Levin
3. Business Statistics by Ken Black, pub: Tata McGraw Hill
4. Schaum's Series for problem practice
5. Mathematical Statistics by Ray, Sharma and Choudhary
6. Business Statistics by V. K. Kapoor, pub: S. Chand

BMAS 0251: COMMERCIAL STATISTICS

Course Objectives: To make the students understand the concept of statistics, index numbers and mathematics of finance.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Data Collection & Representation:** Meaning, Importance, Scope and Limitations of statistics, Types of data, Frequency distribution, Diagrammatic and Graphical representation. **Mathematics of Finance**: Percentage, Ratio and Proportion, Simple & Compound interest, Annuity & its types. **Statistical Average**: Requisite of a good average, Measures of Central tendency & Dispersion, Merits and Demerits.	20
II	**Moments:** Computation of moments, Skewness & Kurtosis by the method of moments. **Correlation & Regression**: Introduction, Correlation between two variables, Karl Pearson's method, Rank correlation, Lines of regression, Simple applications. **Index Number:** Introduction, Types, Constructions of index number, Methods, Tests, Cost of living index number	20

Course Outcomes:

After completion of the course, student will be able to

CO1: Understand the basic concepts of commercial statistics

CO2: Interpret and solve real-life business problem using the concepts of statistics

CO3: Understand and solve problems of measures of central tendency & dispersion

CO4: Apply correlation and regression in real-life situations

Text Books:

- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- P. Gupta, Comprehensive Business Statistics, Laxmi Publications, Delhi, 2011.

Reference Books:

- R. I. Levin and D. Rubin, Statistics for Management, PHI, New Delhi, 1994.
- J. K. Sharma, Business Statistics, Pearson Education, Delhi, 2012.

BMAS 0251: COMMERCIAL STATISTICS

Course Objectives: To make the students understand the concept of statistics, index numbers and mathematics of finance.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Data Collection & Representation:** Meaning, Importance, Scope and Limitations of statistics, Types of data, Frequency distribution, Diagrammatic and Graphical representation. **Mathematics of Finance**: Percentage, Ratio and Proportion, Simple & Compound interest, Annuity & its types. **Statistical Average**: Requisite of a good average, Measures of Central tendency & Dispersion, Merits and Demerits.	20
II	**Moments:** Computation of moments, Skewness & Kurtosis by the method of moments. **Correlation & Regression**: Introduction, Correlation between two variables, Karl Pearson's method, Rank correlation, Lines of regression, Simple applications. **Index Number:** Introduction, Types, Constructions of index number, Methods, Tests, Cost of living index number	20

Course Outcomes:

After completion of the course, student will be able to

CO1: Understand the basic concepts of commercial statistics

CO2: Interpret and solve real-life business problem using the concepts of statistics

CO3: Understand and solve problems of measures of central tendency & dispersion

CO4: Apply correlation and regression in real-life situations

Text Books:

- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- P. Gupta, Comprehensive Business Statistics, Laxmi Publications, Delhi, 2011.

Reference Books:

- R. I. Levin and D. Rubin, Statistics for Management, PHI, New Delhi, 1994.
- J. K. Sharma, Business Statistics, Pearson Education, Delhi, 2012.

BMAS 0251: COMMERCIAL STATISTICS

Course Objectives: To make the students understand the concept of statistics, index numbers and mathematics of finance.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Data Collection & Representation:** Meaning, Importance, Scope and Limitations of statistics, Types of data, Frequency distribution, Diagrammatic and Graphical representation. **Mathematics of Finance**: Percentage, Ratio and Proportion, Simple & Compound interest, Annuity & its types. **Statistical Average**: Requisite of a good average, Measures of Central tendency & Dispersion, Merits and Demerits.	20
II	**Moments:** Computation of moments, Skewness & Kurtosis by the method of moments. **Correlation & Regression**: Introduction, Correlation between two variables, Karl Pearson's method, Rank correlation, Lines of regression, Simple applications. **Index Number:** Introduction, Types, Constructions of index number, Methods, Tests, Cost of living index number	20

Course Outcomes:

After completion of the course, student will be able to

CO1: Understand the basic concepts of commercial statistics

CO2: Interpret and solve real-life business problem using the concepts of statistics

CO3: Understand and solve problems of measures of central tendency & dispersion

CO4: Apply correlation and regression in real-life situations

Text Books:

- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- P. Gupta, Comprehensive Business Statistics, Laxmi Publications, Delhi, 2011.

Reference Books:

- R. I. Levin and D. Rubin, Statistics for Management, PHI, New Delhi, 1994.
- J. K. Sharma, Business Statistics, Pearson Education, Delhi, 2012.

BMAS 1102: ENGINEERING MATHEMATICS II

Course Objectives: To make the students understand the concepts of linear algebra and differential equations by giving more emphasis to their applications in engineering

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Linear Algebra**: Introduction, Types of matrices, Operations on matrices, Complex matrices, Elementary transformations, Rank of a matrix, Consistency and solution of system of linear equations, Eigen values and Eigen vectors. **Ordinary Differential Equations**:Introduction, Solution of n^{th} order linear differential equations with constant coefficients, Complementary function and particular integral, Euler-Cauchy Equations.	20
II	**Solution in Series:** Ordinary point, Regular singular point, Series Solution of linear differential equations of second order, Frobenius method. **Partial Differential Equations:** Introduction, Solution of linear partial differential equations of n^{th} order, Classification of linear partial differential equations of second order, Method of separation of variables	20

Focus: This course focuses on Skill Development aligned with CO's

Course Outcomes:

After studying these topics, the student will be able to

CO1: Know the rank of a matrix and its applications in solving systems of linear equations
CO2: Understand complex matrices
CO3: Find the Eigen values and Eigen vectors of a square matrix
CO4: Solve ordinary and partial differential equations of higher orders
CO5: Classify the linear partial differential equations as elliptic, parabolic and hyperbolic
CO6: Solve the linear differential equations of second order in a series

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.

Reference Books:

- W. E. Boyce and R. D. Prima, Elementary Differential Equations, John Wiley & Sons, 2009.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, Delhi, 2002.

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, PO3
CO4	PO1, PO2, PO3, PO4
CO5	PO1, PO2
CO6	PO1, PO2, PO3, PO6

BMAS 0502: ALGEBRA AND CALCULUS

Course Objectives: To make the students understand the concepts of algebra and calculus by giving more emphasis to their applications in the field of Physics.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Matrices**: Rank by Echelon form, Solution of system of linear equations by elementary transformations and Cramer's rule, Complex matrices, Eigen values and Eigen vectors, Cayley-Hamilton theorem, Model matrix. **Differential Calculus**: Successive differentiation, calculation of n^{th} derivative, Leibnitz theorem, Partial differentiation, Euler's theorem.	20
II	Composite functions, Total derivative, Jacobian and its properties, Expansion of functions of one and two variables. **Integral Calculus**: Beta and Gamma functions, Double and Triple integrals, Change of order, Change of variables. **Vector Calculus:** Gradient, Divergence and Curl, Green's theorem, Gauss' divergence theorem and Stoke's theorem (without proof).	20

Course Outcomes:

After studying these topics, the student will be able to

- **CO1:** Understand partial differentiation and its applications
- **CO2:** Find rank of a matrix and its applications in solving systems of linear equations
- **CO3:** Evaluate double, triple integrals and study their applications
- **CO4:** Find the gradient of a scalar point function and divergence, curl of a vector field

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, New Delhi, 2002.

Reference Books:

- W. E. Boyce and R. D. Prima, Elementary Differential Equations, John Wiley & Sons, 2009.
- G. B. Thomas and R. Finney, Calculus & Analytic geometry, Addison Wesley, USA, 1995.

BMAS 0503: APPLIED MATHEMATICS AND STATISTICS

Course Objectives: To make the students understand the concepts of ordinary differential equations, statistics and numerical methods by giving more emphasis to their applications in chemistry.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Ordinary Differential Equations (ODEs):** Introduction, Formation, Solution of ODEs of I order and I degree, Solution of n^{th} order linear differential equations with constant coefficients, Euler-Cauchy Equations, Simultaneous differential equations. **Numerical Methods:** Errors & its types, Iteration and Newton Raphson method, Finite differences, Missing term technique.	20
II	Interpolation by Newton's forward, backward and divided difference formulae. Numerical integration by trapezoidal and Simpson's rules, Numerical solution of I order ODE by R-K IV order method. **Statistics:** Measures of central tendency and Dispersion, Correlation and Regression, Fitting of straight line by method of least squares, Binomial and Poisson distributions, Statistical hypotheses, Level of significance, Chi– square test as a test of goodness of fit.	20

Course Outcomes:

After studying these topics, the student will be able to

CO1: Solve the ordinary differential equations and know their applications in chemistry

CO2: Apply numerical techniques for numerical differentiation and integration

CO3: Understand the probability distributions

CO4: Test the hypothesis by Chi-square test

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Statistics, Sultan Chand & Sons, Delhi, 2014.
- M. Goyal, Computer Based Numerical and Statistical Techniques, University Science Press, Delhi, 2017.

Reference Books:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.

BMAS 1504: APPLIED MATHEMATICS FOR CHEMISTS

Course Objectives: To make the students understand the concepts of matrices, differentiation, integration and ordinary differential equations by giving more emphasis to their applications in the field of chemistry.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Matrices**: Introduction, Inverse by elementary transformations, Rank by Echelon form, Solution of system of linear equations by elementary transformations and Cramer's rule, Eigen values and Eigen vectors, Cayley-Hamilton theorem. **Differential Calculus**: Introduction, Differentiation of elementary functions, Rules of differentiation, Successive differentiation.	20
II	Expansion of functions of one variable, Integration of elementary functions, Methods of integration. **Ordinary Differential Equations:** Introduction, Solution of ODEs of I order and I degree in variable separable and linear forms, Exact differential equations, Solution of n^{th} order linear differential equations with constant coefficients, Applications to problems in Chemistry.	20

Course Outcomes:

After studying these topics, the student will be able to

CO1: Find rank, Eigen values and Eigen vectors of a given matrix

CO2: Solve the systems of linear equations

CO3: Learn the concepts of differentiation and integration and to use them in different problems

CO4: Solve the ordinary differential equations and know their applications in chemistry

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, New Delhi, 2002.

Reference Books:

- W. E. Boyce and R. D. Prima, Elementary Differential Equations, John Wiley & Sons, 2009.
- G. B. Thomas and R. Finney, Calculus & Analytic geometry, Addison Wesley, USA, 1995.

BMAS 0505: STATISTICS AND NUMERICAL METHODS

Course Objectives: To make the students understand the concepts of statistics and numerical methods by giving more emphasis to their applications in chemistry.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Statistics I:** Importance of Statistics, Measures of central tendency and Dispersion, Moments, Skewness and Kurtosis by method of moments, Introduction to Probability, Addition and Multiplication theorems of probability. **Statistics II:** Binomial and Poisson distributions, Sampling, Statistical hypotheses, Level of significance, Student's t-test.	20
II	Correlation and Regression between two variables, Fitting of straight line by method of least squares. **Numerical Methods:** Errors & its types, Newton Raphson method, Finite differences, Missing term technique, Interpolation by Newton's forward and divided difference formulae, Numerical integration by trapezoidal and Simpson's rules.	20

Course Outcomes:

After studying these topics, the student will be able to

CO1: Fit the straight line to a given data and determine regression lines

CO2: Know probability distributions and the characteristics of frequency distributions

CO3: Solve the problems based on numerical integration

CO4: Learn the concept of sampling and test the hypothesis by Student's t-test

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Statistics, Sultan Chand & Sons, Delhi, 2014.

Reference Books:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.

BP1 06RMT:REMEDIAL MATHEMATICS

Course Objectives: To make the students understand the concepts ofpartial fraction, logarithms, matrices, differentiation, integration, differential equations, straight lines and Laplace transform. by giving more emphasis to their applications.

Credits: 02 **Semester I** **L–T–P-J: 2–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Partial Fraction:** Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into partial fraction, Application of partial fraction in Chemical kinetics and Pharmacokinetics. **Logarithms:** Introduction, Definition, Theorems/ Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, Application of logarithm to solve pharmaceutical problems. **Matrices and Determinants:** Introduction, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix multiplication, Determinants, Properties of determinants, Minors and co-factors, Adjoint or adjugate of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley-Hamilton theorem, Application of matrices in solving Pharmacokinetic equation. **Function:** Real valued function, Classification of real valued functions. **Limits and Continuity:** Introduction, Limit of a function, Definition of limit of a function ($\varepsilon-\delta$ definition), $\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}$, $\lim_{\theta\to 0}\frac{\sin\theta}{\theta}=1.$ **Differentiation:** Introduction, Derivative of a function, Derivative of a constant, Derivative of x^n w.r.t. x, where n is any rational number, Derivative of e^x, Derivative of $\log_e x$, Derivative of a^x, Derivative of trigonometric functions from first principles (without proof).Derivative of a product of a constant and a function, Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) - without proof.	15
II	Successive differentiation, Conditions for a function to be a maximum or a minimum at a point, Application. **Integration:**Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of partial fractions, Integration by parts, Definite integrals, Application. **Analytical Geometry:**Introduction: Signs of Coordinates, Distance formula. Straight Line: Slope or gradient of a straight line, Conditions for	

	parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope intercept form of a straight line. **Differential Equations:** Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear differential equations, Exact equations, Application in solving Pharmacokinetic equations. **Laplace Transform:** Introduction, Definition, Properties of Laplace transform, Laplace transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve linear differential equations, Application in solving Chemical kinetics and Pharmacokinetics equations.	15

Course Outcomes:

After studying these topics, the student will be able to

CO1: Understand proper and improper fractions, logarithms and their properties

CO2: Find the determinant, inverse and characteristic roots of a matrix and solution of system of linear equations

CO3: Learn the concepts of differentiation and integration and to use them in different problems

CO4: Solve first order differential equations and their applications in Pharmaceutics

CO5: Determine the slope and equation of a straight line

CO6: Apply methods of Laplace and inverse Laplace transform

Text Books:

- S. Narayan, Differential Calculus, S. Chand & Co., New Delhi, 1962.
- D. H. Panchaksharappa Gowda, Pharmaceutical Mathematics with Application to Pharmacy, Pharma Med Press, 2014.

Reference Book:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, 1965.

BMAS 0501: BIOSTATISTICS

Course Objectives: To make the students understand the concepts of biostatistics, probability, calculus and algebra.

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

Module No.	Contents	Teaching Hours (Approx.)
I	Logarithms, Introduction and simple problems on Differentiation, Integration (excluding trigonometric functions), Scalar and Vector quantities, Types of vectors, Addition and Subtraction of vectors, Scalar and Vector product of two vectors, Types of matrices, Operations on matrices (addition, subtraction and multiplication). Introduction to Biostatistics, Data collection, Tabulation and Classification of data, Frequency distributions.	20
II	Diagrammatical & Graphical representation of data, Measures of Central tendency and Dispersion, Introduction to Probability (simple problems). Correlation between two variables, Karl Pearson's formula for finding correlation coefficient, Rank correlation, Regression lines, Fitting of straight line & second degree parabola by the method of least squares, Population and sample, Testing of hypothesis, Level of significance, t-test, Chi-square test as a goodness of fit.	20

Course Outcomes:

After studying these topics, the student will be able to

CO1: Attain a basic proficiency in quantitative skills, understand and critically assess data collection and its representation

CO2: Get the knowledge of averages, measures of dispersion to interpret the data

CO3: Understand the correlation between the two variables and concept of regression lines

CO4: Test the hypothesis and apply t and Chi–square tests

Text Books:

- P. Banerjee, Introduction to Biostatistics, S. Chand & Co., Delhi, 2006.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- H. Kishan, Differential Calculus, Atlantic Pub. and Distributors, Delhi, 2008.
- H. Kishan, Integral Calculus, Atlantic Pub. and Distributors, Delhi, 2005.

Reference Books:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- B. K. Mahajan, Methods in Biostatistics, Jaypee Publications, New Delhi, 2010.

MMAS 0501: ADVANCED BIOSTATISTICS

Course Objectives: To make the students understand the advanced concepts of biostatistics, algebra and differential equations.

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

Module No.	Contents	Teaching Hours (Approx.)
I	Introduction to Vector algebra, Scalar & Vector triple products, Collinear and Coplanar vectors, Determinant and its properties, Adjoint and Inverse of a matrix (simple problems), Formation of ordinary differential equations (ODEs), Solution of ODE of I order and I degree (Variable separable and Linear forms). Introduction to Biostatistics, Revision of measures of central tendency and dispersion.	20
II	Computation of moments, Skewness and Kurtosis by the method of moments, Introduction to probability, Additive and multiplicative laws, Conditional probability. Method of least squares for fitting of exponential curves, Sampling, Testing of hypothesis, Type I and type II errors, Level of Significance, Degree of freedom, Students' t-test, F–test, Chi-square test as a goodness of fit and as a test of independence, ANOVA (one way classification).	20

Course Outcomes:

After studying these topics, the student will be able to

- **CO1:** Recognize and give example of different type of data arising in public health and clinical studies
- **CO2:** Interpret difference in data, select appropriate test for comparing populations
- **CO3:** Test the hypothesis and apply t, F and Chi-square tests
- **CO4:** Understand one way classification of analysis of variance

Text Books:

- P. Banerjee, Introduction to Biostatistics, S. Chand & Co., Delhi, 2006.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- H. Kishan, Differential Equations, Atlantic Publishers and Distributors, Delhi, 2008.

Reference Books:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- B. K. Mahajan, Methods in Biostatistics, Jaypee Brothers Pub., New Delhi, 2010.

MMAS 0502: MATHEMATICS FOR CHEMISTS

Course Objectives: To make the students understand the concepts of algebra, calculus and statistics by giving more emphasis to their applications in the field of chemistry.

Credits: 02 **Semester I** **L–T–P-J: 2–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Algebra:** Introduction to matrices, Determinant, Adjoint and Inverse of a matrix, Elementary operations, Rank of a matrix by Echelon form, Solution of system of linear equations by rank test and Cramer's rule, Revision of vector products, Point functions, Gradient, Divergence and Curl. **Calculus:** Differentiation and integration of standard functions, Product, quotient and chain rules for differentiation.	15
II	Extrema of functions of one variable, Integration by substitution, by parts and by partial fraction, Definite integral and its properties. Simple applications. **Statistics:** Measures of central tendency and dispersion, Correlation and Regression, Fitting of straight line by method of least squares. Introduction to probability, Binomial and Poisson distributions.	15

Course Outcomes:

After studying these topics, the student will be able to

CO1: Understand differentiation and integration
CO2: Find rank of a matrix & its applications in solving systems of linear equations
CO3: Calculate the measures of central tendency and dispersion
CO4: Find the gradient of a scalar point function and divergence, curl of a vector field

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Pub., Delhi, 2014.
- Mathematics books for Class XI & XII, NCERT Publications.

Reference Books:

- P. Gupta, Comprehensive Mathematics (for Class XI & XII), Laxmi Pub. (P) Ltd. Delhi, 2005.
- S. C. Gupta and V. K. Kapoor, Fundamentals of Statistics, Sultan Chand & Sons, Delhi, 2014.

BMAS 0103: ENGINEERING MATHEMATICS III

Course Objectives: To make the students understand the concept of Fourier series, Laplace transform, complex analysis and applications of partial differential equations in engineering.

Credits: 04 **Semester III** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Fourier series**: Fourier series of period 2π , Half range series, Change of interval. **Applications of Partial Differential Eqns.:** Classification of II order PDEs, Method of separation of variables, Applications in solving one and two dimensional wave and heat flow equations, Laplace equation in cartesian and polar coordinates, Transmission line equations. **Laplace Transform:** Properties of Laplace transform, Laplace transform of derivatives and integrals, Laplace transform of Unit step, Dirac-delta and periodic functions.	20
II	**Inverse Laplace Transform:** Properties of inverse Laplace transform, Convolution theorem, Application in solving ordinary differential equations. **Complex Analysis:** Analytic and Harmonic functions, Line integral in a complex plane, Cauchy's integral theorem and formula, Taylor and Laurent series (without proof), Singularities, Residue at a pole, Residue theorem and its application in evaluation of real integrals (excluding poles on the real axis).	20

Focus: This course focuses on Skill Development aligned with CO's

Course Outcomes:

After studying these topics, the student will be able to

CO1: Find Fourier series representation of function of one variable
CO2: Apply Laplace transforms in solving differential equations
CO3: Know the concept of analytic function and its applications in engineering
CO4: Application of Partial Differential Equations

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publications, Delhi, 2014.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, Delhi, 2002.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.

Reference Books:

- R. V. Churchill and J. W. Brown, Complex Variables and Applications, McGraw – Hill, New York, 2009.
- J. M. Howie, Complex Analysis, Springer–Verlag, USA, 2004.

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

COs	POs/ PSOs
CO1	PO1, PO2
CO2	PO1, PO2, PO4
CO3	PO1, PO2, PO3
CO4	PO1, PO2, PO3, PO6

BMAS 0104: ENGINEERING CALCULUS

Course Objectives: To make the students understand the concepts of differentialcalculus, integral calculus and vector calculus by giving more emphasis to their applications in engineering.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Differential Calculus**: Calculation of n^{th} order derivatives, Leibnitz theorem, Partial derivatives, Euler's theorem for homogeneous functions, Composite functions, Total derivatives, Expansion of functions of several variables, Jacobian and its properties, Extrema of functions of several variables using Lagrange's method of multipliers.	20
II	**Integral Calculus**: Beta and Gamma functions, Double and Triple integrals, Change of order of integration, Change of variables. **Vector Calculus:** Gradient, Divergence and Curl of point functions, Vector identities, Line, Surface and Volume integrals, Green's theorem, Gauss' divergence theorem and Stoke's theorem (without proof).	20

Focus: This course focuses on Skill Development aligned with CO's

Course Outcomes:

After studying these topics, the student will be able to

CO1: Compute n^{th} order derivative and study its application in Leibnitz theorem
CO2: Understand partial differentiation and its applications
CO3: Evaluate double and triple integrals and study their applications
CO4: Learn the use of change of variables in solving multiple integrals
CO5: Find the gradient of a scalar field and divergence, curl of a vector field
CO6: Know various integral theorems related to line, surface and volume integrals

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, New Delhi, 2002.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.

Reference Books:

- T. M. Apostol, Calculus, Volume I, John Wiley & Sons, Inc., USA, 1967.
- T. M. Apostol, Calculus, Volume II, Xerox Corporation, USA, 1969.
- G. B. Thomas and R. Finney, Calculus and Analytic geometry, Addison Wesley, USA, 1995.

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, PO3
CO4	PO1, PO2, PO3, PO4
CO5	PO1, PO2
CO6	PO1, PO2, PO3, PO6

BMAS 0105: LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS

Course Objectives: To make the students understand the concepts of linear algebra, Fourier series and differential equations by giving more emphasis to their applications in engineering.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Linear Algebra**: Introduction, Elementary transformations, Rank of a matrix, Consistency and solution of system of linear equations, Linear dependence and independence of vectors, Complex matrices. Eigen values, Eigen vectors, Cayley–Hamilton theorem and its applications. **Ordinary Differential Equations:** Introduction,Solution of n^{th} order linear differential equations with constant coefficients, Euler-Cauchy equations, Simultaneous differential equations, Method of variation of parameters.	20
II	**Fourier Series:** Half range sine and cosine series, Change of interval. **Partial Differential Equations**: Introduction, Solution of linear partial differential equations of n^{th} order, Classification of linear partial differential equations of second order, Method of separation of variables and its application in solving one-dimensional wave and heat flow equations.	20

Focus: This course focuses on Skill Development aligned with CO's

Course Outcomes:

After studying these topics, the student will be able to

CO1: Know the rank of a matrix and its applications in solving systems of linear equations
CO2: Find the Eigen values and Eigen vectors of a square matrix
CO3: Solve ordinary and partial differential equations of higher orders
CO4: Classify the linear partial differential equations as elliptic, parabolic and hyperbolic
CO5: Expand a function in half range Fourier sine and cosine series
CO6: Apply the method of separation of variables to solve wave and heat flow equations of one dimension

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.

Reference Books:

- W. E. Boyce and R. D. Prima, Elementary Differential Equations, John Wiley & Sons, 2009.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, Delhi, 2002.

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, PO3
CO4	PO1, PO2, PO3, PO4
CO5	PO1, PO2
CO6	PO1, PO2, PO3, PO6

BMAS 0130: ELEMENTARY MATHEMATICS I

Course Objectives: To make the students understand the concepts of algebra and differential calculus.

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

Module No.	Contents	Teaching Hours (Approx.)
I	**Algebra:** Complex numbers, Solution of quadratic equations, Introduction to matrices, Types of matrices, Operations on matrices, Minors and Co-factors, Determinant, Transpose, Adjoint and Inverse of a matrix, Solution of system of linear equations by Cramer's rule, Partial fractions.	20
II	Introduction to Vector algebra, Scalar & Vector products, Collinear and Coplanar vectors. Arithmetic and geometric progression. **Differential Calculus:** Functions, Properties of standard functions (trigonometric, exponential and logarithmic) and their graphs, Concept of limit, Differentiation of algebraic, exponential, logarithmic, trigonometric, inverse trigonometric and hyperbolic functions, Product, quotient and chain rules, Maximum and minimum of a function of one variable.	20

Course Outcomes:

After studying these topics, the student will be able to

- **CO1:** Determine the roots of a quadratic equation
- **CO2:** Find the inverse of a given matrix and solve the systems of linear equations
- **CO3:** Know arithmetic and geometric progressions
- **CO4:** Learn the concept of vectors and vector products
- **CO5:** Understand the differentiation of a function and its applications

Text Books:

- Mathematics books for Class XI & XII, NCERT Publications.
- P. Gupta, Comprehensive Mathematics (for Class XI & XII), Laxmi Pub. (P) Ltd. Delhi.

Reference Book:

- G. B. Thomas and R. Finney, Calculus & Analytic geometry, Addison Wesley, USA, 1995.

BMAS 0131: CALCULUS AND STATISTICS

Course Objectives: To make the students understand the advanced concepts of integration, ordinary differential equations and biostatistics.

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

Module No.	Contents	Teaching Hours (Approx.)
I	Integration of algebraic, exponential, logarithmic, trigonometric and hyperbolic functions, Integration by parts, substitution & partial fractions, Definite integrals and its properties. Introduction to Biostatistics, Measures of central tendency and dispersion.	20
II	Differential equation, order, degree, Solution of ODE of I order and I degree (Variable separable, homogeneous, linear and exact forms) and its applications to biological problems (population growth, radioactive decay). Correlation and Regression, Computation of moments, Skewness and Kurtosis by the method of moments.	20

Course Outcomes:

After studying these topics, the student will be able to

CO1: Find the integration by various methods
CO2: Solve the ordinary differential equations of first order and first degree
CO3: Understand the concepts of measures of central tendency
CO4: Calculate moments, correlation and regression

Text Books:

- Mathematics books for Class XI & XII, NCERT Publications.
- B. K. Mahajan, Methods in Biostatistics, Jaypee Brothers Pub., New Delhi, 2010.

Reference Books:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.

BAGS 0104: ELEMENTARY MATHEMATICS

Course Objectives: To make the students understand the concepts of straight line, circle, differentiation, integration and matrices.

Credits: 02 **Semester I** **L–T–P-J: 2–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Straight Line:** Distance Formula, Section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two Points form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two straight lines, Angle between two straight lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines, Area of triangle and quadrilateral. **Circle:** Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameter is line segment joining two points (x_1, y_1) and (x_2, y_2), Tangent and Normal to a given circle at given point (Simple problems), Condition of tangency of a line $y = mx + c$ to the given circle $x^2 + y^2 = a^2$.	10
II	**Differential Calculus:** Definition of function, limit and continuity, Simple problems of limit, Simple problems on continuity, Differentiation of x^n, e^x, sin x and cos x from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problems based on it), Logarithmic differentiation (Simple problems based on it).Differentiation by substitution method and simple problems based on it, Differentiation of inverse trigonometric functions, Maxima and minima of the functions of the form y = f(x) (Simple problems based on it). **Integral Calculus:** Integration of simple functions, Integration of product of two functions, Integration by substitution method, Definite integral (Simple problems based on it), Area under simple well known curves (Simple problems based on it), **Matrices and Determinants:** Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3^{rd} order, Properties of determinants up to 3^{rd} order and their evaluation.	10

Course Outcomes:

After studying these topics, the student will be able to

CO1: Find the equation of a line, angle between two lines and its applications

CO2: Compute the equation of a circle and tangent and normal to a given circle

CO3: Apply various methods for differentiation and integration of functions

CO4: Learn the operations on matrices and calculate the determinant of a matrix

Text Book:

- Mathematics books for Class XI & XII, NCERT Publications.

Reference Book:

- P. Gupta, Comprehensive Mathematics (for Class XI & XII), Laxmi Pub. (P) Ltd. Delhi, 2005.

BAGS 0113: STATISTICAL METHODS

Course Objectives: To make the students understand the concepts of statistical methods by giving more emphasis to their applications in agriculture.

Credits: 02 **Semester III** **L–T–P-J: 1–0–1-0**

Module No.	Contents	Teaching Hours (Approx.)
I	Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation.	07
II	Linear Regression Equations. Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table. Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.	08
Practical	Graphical Representation of Data. Measures of Central Tendency (Ungrouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Central Tendency (Grouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Dispersion (Ungrouped Data). Measures of Dispersion (Grouped Data). Moments, Measures of Skewness & Kurtosis (Ungrouped Data). Moments, Measures of Skewness & Kurtosis (Grouped Data). Correlation & Regression Analysis. Application of One Sample t-test. Application of Two Sample Fisher's t-test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2 ×2 contingency table. Analysis of Variance One Way Classification. Analysis of Variance Two Way Classification. Selection of random sample using Simple Random Sampling.	15

Course Outcomes:

After studying these topics, the student will be able to

CO1: Know the rank of a matrix and its applications in solving systems of linear equations
CO2: Understand complex matrices
CO3: Find the Eigen values and Eigen vectors of a square matrix
CO4: Solve ordinary and partial differential equations of higher orders
CO5: Classify the linear partial differential equations as elliptic, parabolic and hyperbolic
CO6: Solve the linear differential equations of second order in a series

Text Books:

- M. Goyal and N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publication, Delhi, 2014.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2014.

Reference Books:

- W. E. Boyce and R. D. Prima, Elementary Differential Equations, John Wiley & Sons, 2009.
- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, Delhi, 2002.

COURSES

(w.e.f. Session 2020-21)

PhD

(FULL TIME/PART TIME)

PMAE 0010: COMPUTER SKILLS, TENSOR AND RIEMANNIAN GEOMETRY

Course Objectives: To make the students understand the concepts of tensors and Riemannian geometry and know the software packages by giving more emphasis to their applications.

Credits: 04 **Semester I** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Computer Skills I:** Introduction to Latex, MATHEMATICA and MAPLE. **Tensor and Riemannian Geometry I:** Tensor calculus, n-dimensional space V_n, Superscript and subscript, Transformation of coordinates, Transformation law of tensor, Product of two tensors, Contraction, Trace of a tensor, Quotient law, Metric tensor and Riemann space. **Computer Skills II:** Introduction to Excel, Chart, Functions. Power point presentation, Introduction to C language. **Tensor and Riemannian Geometry II:** Associated and Reciprocal or conjugate tensor, Symmetric and anti-symmetric tensor, Tensor density, Levi-Civita tensor, Christoffel symbols, Law of transformation of Christoffel symbols, Covariant differentiation, Riemannian Affine connection, Covariant derivative of a vector density, Riemannian metric, Geodesics, Null geodesics, Tensor form of gradient, divergence, Laplacian and curl. **Tensor and Riemannian Geometry III:** Intrinsic derivative, Riemannian and normal coordinates, Gaussian coordinates, Parallel transport, Geodesics as auto parallel curves, Parallel propagation, Riemann curvature tensor R^i_{ljk}, Covariant curvature tensor, Symmetric properties of R^i_{ljk}, Covariant curvature tensor R_{hljk}, Number of independent components of R_{hljk}, Ricci tensor, Bianchi identities, Conformal curvature tensor, Algebraic classification of the conformal curvature tensor, Conformal invariance, Geodesic deviation, Lie derivative.	40

Focus: This course focuses on Employability and Skill Development aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Use software packages in research

CO2: Learn different types of tensors

CO3: Find Christoffel symbols and use them in the computation of different curvature tensors

CO4: Understand covariant differentiation, Bianchi identities and their applications

Text Books:

- S. R. Roy and Raj Bali, Theory of Relativity, Jaipur Publishing House, 2008.
- S. K. Srivastava, General Relativity and Cosmology, PHI Pvt. Ltd., 2008.
- Leslie Lamport, A Document Preparation System: Latex, Addison-Wesley Professional, 1994.

- Y. K. Singh and B. B. Chaudhary, MATLAB Programming, PHI, 2007.

Reference Book:

- J. V. Narlikar, Cosmology, Cambridge University Press, 2002.

PMAE 0011: RELATIVITY AND COSMOLOGY

Course Objectives: To make the students understand the concepts of general relativity and cosmology by giving more emphasis to their applications.

Credits: 04 **Semester I/II** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Special Theory of Relativity:** Inertial and non-inertial frames, Special and General Galilean transformations, Lorentz transformation and its geometrical interpretation, Transformation formula for mass, density, momentum, energy and force, Minkowski-space, Relativistic equation of motion, Four vectors and tensors in Minkowski space, Lagrangian and Hamiltonian formulation of Relativistic Mechanics. **General Relativity:** Principles of equivalence and general covariance, Mach's Principle, Einstein's field equations, Energy momentum tensors, Gravitational equations, Vectors and tensors, Experimental tests of general relativity, Alternatives theories of gravitations, FRW model, Schwarzschild solution, Cosmological solutions in Brans-Dicke Theory, Kaluza's five dimensional theory, Cosmological models, Singularity in cosmological models. **Cosmology:** Static cosmological models, Newtonian cosmology, Einstein universe, Expanding universe, Friedmann models, Cosmological models with non-zero cosmological term, The early universe, The inflationary universe, Primordial black holes, Dark energy and dark matter, Observational constraints on cosmological parameters, Standard cosmology.	40

Focus: This course focuses on Employability aligned with CO2 and CO3

Course Outcomes:

After studying these topics, the students will be able to

CO1: Understand the basic principles of cosmology

CO2: Know the significance the Einstein's theories of special and general relativity

CO3: Deal with the cosmological models

CO4: Learn various theories of gravitation

Text Books:

- S. R. Roy & Raj Bali, Theory of Relativity, Jaipur Publishing House, 2008.
- J. V. Narlikar, An Introduction to Cosmology, Cambridge University Press, 2002.

Reference Books:

- S. Weinberg, Cosmology, Oxford University Press, 2008.
- S. K. Srivastava, General Relativity and Cosmology, PHI Pvt. Ltd., 2008.

PMAE 0020: INVENTORY MODELING

Course Objectives: To make the students understand the various inventory models with deterministic & probabilistic demands, price breaks and different demand functions.

Credits: 04 **Semester I** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Basics of Inventory Models (IM)**: Necessity of IM, Inventory costs, Basic definitions, Classification of IM. **Inventory Models with Deterministic Demand:** (1) Demand rate uniform, production rate infinite, (2) Demand rate non uniform and production rate infinite, (3) Demand rate uniform and production rate finite, (4) Demand rate uniform, production rate infinite & shortages allowed, (5) Demand rate uniform, production rate finite & shortages allowed. **Inventory Models with Probabilistic Demand:** (1) Instantaneous demand, setup cost zero, stock level discrete and lead time zero (2) Instantaneous demand, setup cost zero, stock level continuous and lead time zero (3) Continuous demand, setup cost zero, stock level discrete and lead time zero (4) Continuous demand, setup cost zero, stock level continuous and lead time zero (5) Continuous demand, setup cost zero, stock level discrete with lead time. **Inventory Models with Price Breaks:** Purchase inventory models with one and two price breaks **Inventory Models with different demand functions:** Inventory models with price and time dependent demand, Inventory models with price, time and stock dependent demand, Inventory models with seasonal demand.	40

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Learn inventory model and its types

CO2: Understand the inventory models with uniform and non-uniform demand rate

CO3: Know the inventory models with instantaneous/ continuous demand with discrete/ continuous stock level and lead time zero

CO4: Minimize the total inventory holding costs and ordering costs

Text Books:

- P. K. Gupta & D. S. Hira, Operations Research, S. Chand Publication, 2014.
- Sven Axsäter, Inventory Control, Springer, 2000.

Reference Book:

- E. L. Porteus, Foundations of Stochastic Inventory Theory, Stanford University Press, 2002.

PMAE 0021: RANDOM VARIABLES AND SOFTWARE TOOLS

Course Objectives: To make the students understand the concepts of probability distribution, use of software tools and LaTeX.

Credits: 04 **Semester I/II** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Random Variables** - Discrete and Continuous, Cumulative Distribution and Probability Density Function, Discrete Random Variables, Probability Mass Function and Cumulative Distribution Function, Expectation of Variables, Moments and Variance, Skewness and Kurtosis, Degenerate and Discrete Uniform Distributions, Bernoulli and Binomial Distribution, Poisson Distribution, Geometric Distribution, Continuous Random Variables and Uniform Distribution, Normal Distribution. **Software Tools** - Introduction to softwares: Mathematica, Matlab, SPSS and R. Plotting of functions, Symbolic computation, Differentiation and Integration, Numerical solution of equations. Introduction to LaTeX, Syntax, Font Selection, Formatting Text, Page Layout and style, Table preparation, Equation writing, Bibliography with LaTeX.	40

Focus: This course focuses on Employability and Skill Development aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Understand the probability distributions.
CO2: Apply the probability distribution in inventory models.
CO3: Use Mathematica software to get the solution of real-life inventory models.
CO4: Write research article in LaTeX.

Text Books:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics: Sultan Chand & Sons, 2014.
- S. Wolfram, The Mathematica book: Wolfram Media, Inc, 2004.
- S. Kottwitz, LaTeX beginner's Guide, Packt Publishing, 2011.

Reference Books:

- G. Grätzer**,** More Math Into LaTeX, Springer, 2016.
- E. Don, Schaum's Outline of Mathematica and the Wolfram Language, Mc Graw Hill Education, 2018.

PMAE 0030: PARTIAL DIFFERENTIAL EQUATIONS: METHODS AND APPLICATIONS

Course Objectives: To make the students understand the various analytic and semi analytic approaches to solve linear and nonlinear partial differential equations with given initial and boundary conditions by giving more emphasis to their applications in the real world.

Credits: 04 **Semester I** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**I Order Linear Partial Differential Equations (PDEs)**: Solution by Adomian decomposition method (ADM), The noise terms phenomenon. Solution by the modified decomposition method (MDM) and the variational iteration method (VIM). Method of characteristics, Solution of systems of linear PDEs by ADM and VIM. **Heat Flow and Wave Equations by ADM and VIM**: Solution of homogeneous and inhomogeneous one dimensional heat and wave equations by ADM and VIM. Solution of higher dimensional heat flow & wave equations by ADM. Solution of Laplace's equation with Dirichlet, Neumann and Robin Boundary conditions by ADM. **Non – linear Partial Differential Equations:** Calculation of Adomian polynomials, Solution of nonlinear PDEs by ADM, MDM and VIM, Solution of non-linear PDEs systems, Nonlinear advection problem, Goursat problem, Klein–Gordon, Sine–Gordon, Burger's, Telegraph, Schrodinger, Korteweg – deVries (KdV) equations by ADM and VIM.	40

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

- **CO1:** Understand various numerical methods for solving differential equations
- **CO2:** Apply the semi analytic methods in real world problems
- **CO3:** Explore new applications of the aforesaid methods
- **CO4:** Solve the non-linear PDE numerically

Text Books:

- A. M. Wazwaz, Partial Differential Equations and Solitary Wave Theory, Springer, 2009.
- A. M. Wazwaz, Partial Differential Equations: Methods and Applications, Balkema Publishers, 2002.

Reference Books:

- G. Adomian, Solving Frontier Problems of Physics: The Decomposition Method, Kluwer Academic Publishers, 1994.
- L. Debnath, Non–Linear Partial Differential Equations for Scientists and Engineers, Birkhauser, Springer, 2012.
- L. C. Evans, Partial Differential Equations, American Mathematical Society, 1998.

PMAE 0040: COMPUTER BASED NUMERICAL TECHNIQUES AND SOFT COMPUTING

Course Objectives: To make the students understand the concepts of numerical techniques, artificial neural networks, genetic algorithm and fuzzy logic by giving more emphasis to their applications in soft computing.

Credits: 04 **Semester I** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Introduction:** Brief review & updates of concepts & applications of computer and computer programming, Modern trends. **Numerical Techniques**: Finding roots of equation & optimization, Least-square-fitting, Laplace-Transform and its applications for the numerical solution of differential equations, FEM and its applications. **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 and Crisp sets, Fuzzy membership and Fuzzy operations, Properties of fuzzy sets, Linguistic hedges, Fuzzy logic – T-norms and other aggregation operators, Crisp and 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, Fuzzyfications & Defuzzifications, 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, operators of GA, Crossover and mutation, Basics of genetic algorithm with example for maximize, Introduction to genetic programming and Basic concepts.	40

Focus: This course focuses on Employability and Skill Development aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

- **CO1:** Implement code for numerical methods to find the solution of non-linear equations or the system of linear equations
- **CO2:** Develop code for numerical methods to estimate the solution of higher order ordinary differential equations or systems of first order ordinary differential equations
- **CO3:** Construct graphical displays of science/engineering data and interpret the role of such displays in data analysis

CO4: Analyze various neural network architectures
CO5: Define the fuzzy systems
CO6: Analyze the genetic algorithms and their applications

Text Books:

- S. Rajsekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, Prentice Hall of India, 2011.
- Y. P. Kanetkar, Let us C, BPB publications, 2004.
- V. Rajaraman, Computer oriented numerical methods, PHI Learning Pvt. Ltd., 2018.

Reference Books:

- T. J. Ross, Fuzzy Logic with Engineering Applications, John Wiley and Sons, 2016.
- D. E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning, Adission-Wesley, 2016.
- Karray, Soft Computing and Intelligent Systems Design: Theory, Tools and Applications, Pearson Education, 2009.

PMAE 0041: APPLIED STATISTICS AND OPTIMIZATION TECHNIQUES

Course Objectives: To make the students understand the concepts of statistics and optimization techniques by giving more emphasis to their applications in soft computing.

Credits: 04 **Semester I** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Random Variables:** Definition, Cumulative distribution function, Continuous, Discrete and Mixed random variables, Probability density function, Probability mass function. 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. **Probability Distributions and Testing of Hypothesis:** Binomial, Poisson and Normal distributions. Introduction to Statistical analysis, Population distribution, Sampling and Non sampling Errors, Point estimation, Interval estimation, Student's t-distribution, Chi Square distribution, F-distribution. **Optimization Techniques:** Introduction, Classification of Optimization problems, Classical optimization techniques: Single variable optimization, Multivariable optimization with no constraints, Multivariable optimization with equality constraints. **Non-linear Programming:** Minimization methods, Introduction, Exhaustive search, Direct root method, Newton method, Secant method, Unconstrained optimization techniques, Gradient method, Constrained optimization techniques, Decision theory. **Stochastic Processes:** Definition and Classification of Stochastic processes, Poisson process, Birth and Death process, Applications to queues, Discrete time Markov chains.	40

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

- **CO1:** Apply the concepts of probability, random variables and operation research in the area of computer networks, image processing etc.
- **CO2** Use statistical methods for the design and analysis of computer simulation experiments
- **CO3:** State and define the inference from small samples including difference between two means, paired differences, population variances, and two population variances
- **CO4:** Understand the characteristics of different types of decision-making environments and the appropriate decision-making approaches
- **CO5:** Learn Poisson process and its applications in queuing theory

Text Books:

- K. S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, Wiley, 2016.
- H. A. Taha, Operations Research - An Introduction, Prentice Hall, 2011.

Reference Books:

- Papoulis and S. U. Pillai, Probability, Random Variables and Stochastic Processes, Tata McGraw Hill, 2017.
- R. M. Gray and L. D. Davisson, An Introduction to Statistical Signal Processing, Cambridge University Press, 2004.
- S. L. Miller and D. G. Childers, Probability and Random Processes, Academic Press, 2012.
- Y. Viniotis, Probability and Random Processes for Electrical Engineers, McGraw Hill, 1998.
- S. D. Sharma, Computer Based Optimization Techniques, Kedar Nath Ram Nath Publication, 2011.
- K. Swaroop and Man Mohan, Operation Research, Sultan Chand & Sons, 2011.
- D. S. Hira and P. K. Gupta, Operation Research, S. Chand Publication, 2005.

PMAE 0050: DIFFERENTIAL GEOMETRY OF MANIFOLDS

Course Objectives: To make the students understand the concepts of surface, tangent vectors, tangent plane, curvature and differential manifold by giving more emphasis to their applications in differential geometry.

Credits: 04 **Semester I** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	Functions on Euclidean spaces, Continuity, Differentiability, Partial and Directional derivatives, Chain rule, Inverse function theorem, Implicit function theorem, Smooth Urysohn lemma, Partition of unity, Change of variables. Regular surfaces in R^3, Coordinate neighbourhoods, Tangent vectors, Tangent plane, Normal fields, Orientability, Examples of surfaces, Level sets of smooth functions on R^3. Smooth functions on surfaces, Differential of a smooth function, Gauss map, Shape operator (or Weingarten map), Normal sections, Principal curvatures, Gaussian and Mean curvature, Theorema Egregium, Isometries of surfaces. Differential manifolds, Differential functions on manifolds, Tangent spaces, Vector fields, Differential forms on manifolds, Orientations, Integration on manifolds, Stoke's theorem on manifolds	40

Focus: This course focuses on Employability aligned with all CO3, CO4 and CO5

Course Outcomes:

After studying these topics, the students will be able to

CO1: Understand change of variables
CO2 Know regular surfaces and orientability
CO3: Use Weingarten map, principal curvatures and isometries of surfaces
CO4 Solve the problems based on Gauss map, normal sections, Gaussian and mean curvature
CO5: Learn the concept of differential forms on manifolds and integration on manifolds

Text Books:

- M. Spivak, Calculus on Manifolds, Addison-Wesley, 1965.
- J. R. Munkers, Analysis on Manifolds, Addison-Wesley, 1991.

Reference Books:

- A. Pressley, Elementary Differential Geometry, Springer, 2001.
- A. Gray, Modern Differential Geometry of Curves and Surfaces with Mathematica, CRC Press, 1997.

PMAE 0051: RIEMANN-FINSLER GEOMETRY

Course Objectives: To make the students understand the concepts of Finsler metric, Chern connection, flag curvature, Riemann curvature, Parallel translation and Jacobi field by giving more emphasis to their applications in Finsler geometry.

Credits: 04 **Semester I/II** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	Minkowski norm, Finsler metric, Length Structure and Volume Form, Randers metric. Chern connection, Flag Curvature, Finsler metric of constant flag curvature, Finsler metric of scalar flag curvature. Projective Finsler metric, Projective flat Finsler metrics, Parallel vector Fields, Parallel translation, Landsberg metric, Berwald metric. Riemann curvature, S-Curvature, Isotropic S-curvature, Exponential map, First and second variation, Jacobi field. Maple programs for Spray Coefficients of two dimensional Finsler metric, Gauss curvature, Spray Coefficients of (α, β) metric.	40

Focus: This course focuses on Employability aligned with CO2, CO3 and CO6

Course Outcomes:

After studying these topics, the students will be able to

CO1: Know Finsler metric, Randers metric and Chern connection
CO2 Understand Finsler metric of constant and scalar flag curvatures.
CO3: Solve the problems based on projective and projective flat Finsler metrics
CO4 Learn Landsberg and Berwald metrics
CO5: Find parallel vector fields, parallel translation, Riemann curvature, S-curvature and exponential map
CO6: Calculate spray coefficients and Gauss curvature using Maple

Text Books:

- Z. Shen, Differential Geometry of Spray and Finsler Space, Kluwer Academic publishers, 2001.
- Z. Shen, Lectures on Finsler Geometry, Lectures on Finsler Geometry, World Scientific, 2001.
- S. S. Chern and Z. Shen, Riemannian Finsler Geometry, World Scientific, 2004.

Reference Books:

- D. Bao, S. S. Chern and Z. Shen, An Introduction to Riemannian-Finsler Geometry, GTM, Springer, 2000.
- P. L. Antonelli, R. S. Ingarden, M. Matsumoto, The Theory of Sprays and Finsler Spaces with Application in Physics and Biology, Kluwer Academic Publishers, 1993.
- M. Matsumoto, Foundations of Finsler Geometry and Special Finsler spaces, Kaiseisha Press, Japan 1986.

PMAE 0060: COMPUTER SKILLS AND FLUID DYNAMICS

Course Objectives: To make the students understand the concepts of fluid, its properties and behavior under various conditions of internal and external flows.

Credits: 04 **Semester I** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Computer Skills :** Introduction to Latex, MATHEMATICA and MAPLE **Basic Concepts of Fluid Dynamics:** Real fluids and ideal fluids, stream lines, steak lines and path lines, steady and unsteady flows, Lagrangian and Eulerian description, fundamental principles of conservation, conservation of mass, equation of continuity, Reynolds transport theorem. **Governing Equations of Fluid Dynamics:** The continuity equation, momentum equation, energy equation, conservation of linear momentum, Navier-Stokes equation, conservation of energy, general scalar transport equation, Boussinesq approximation, some solvable fully developed viscous flow: (i) steady flow between parallel plates, (ii) steady flow in a pipe, (iii) steady flows between concentric cylinders. **Dimensional Analysis** Reynolds law of similarity, physical signification of some non-dimensional parameters: Prandtl number, Mach number, Reynolds number, Rayleigh number, Grashof number, Nusselt number, Laminar steady flow of incompressible viscous fluids in tubes of circular and rectangle cross- section. **Turbulence and its Modelling:** Characteristics of turbulence, effect of turbulent fluctuations on mean flow, turbulent flow calculations, turbulence modelling.	40

Focus: This course focuses on Employability and Skill Development aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Understand physical properties of a fluid

CO2 Know the classification of the basic equations of fluid dynamics

CO3: Recognize the type of fluid flow occurring in a particular physical system and to use the appropriate model equations to investigate the flow

CO4 Learn the dimensional analysis

Text Books:

- P. G. Drazin and W. H. Reid, Hydrodynamic Stability, Cambridge University Press, 2004.
- S.V. Parankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill. 1980.

- K. Muralidhar and G. Biswas, Advanced Engineering Fluid Mechanics, Narosa Publishing House, 2006.

Reference Books:

- G. D. Smith, Numerical Solution of Partial Differential Equations: Finite Difference Methods, Clarendon Press, 1985.
- Y. K. Singh and B. B. Chaudhary, MATLAB Programming, PHI, 2007.

PMAE 0061: COMPUTATIONAL METHODS FOR FLUID DYNAMICS

Course Objectives: To make the students understand the concepts of stepwise procedure to completely solve a fluid dynamics problem using computational methods.

Credits: 04 **Semester I** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Introduction to Computational Fluid Dynamics (CFD):** Advantages and applications of computational field, governing equations for CFD, continuity equation, momentum equation, energy equation, additional equations for turbulent flow. **CFD Techniques**: Discretization of governing equations, Finite-difference method, finite-volume method, converting governing equation to algebraic equation system, numerical solutions to algebraic equations-Direct method, iterative methods, pressure velocity coupling. **Hydrodynamic Stability:** Mathematical formulation of the stability problem of incompressible flow, method of normal modes, Squire's theorem and Orr-Sommerfeld equation; concept of boundary layers, fluid flow through a porous medium; porosity, permeability, Darcy law and its extensions.	40

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Understand CFD technique

CO2: Demonstrate the ability to analyze a flow field to determine various quantities of interest, such as flow rates, heat fluxes, pressure drops, losses, etc., using flow visualization and analysis tools

CO3: Learn the hydrodynamics stability

CO4 Simulate simple CFD models and analyze its results

Text Books:

- J. Tu, G. Heng Yeoh and C. Liu Computational Fluid Dynamics: A practical Approach, Butterworth-Heinemann, 2018.
- S.V. Parankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill. 1980.
- T. J. Chung, Computational Fluid Dynamics, Cambridge University Press, 2010.
- J. H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, Springer, 2002.
- G. D. Smith, Numerical Solution of Partial Differential Equations: Finite Difference Methods, Clarendon Press, 1985.

Reference Book:

- H. K. Versteeg and W. Malalasekera, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson, 2010.
- J. C. Tannehill, D. A. Anderson and R. H. Pletcher, Computational Fluid Mechanics and Heat Transfer, McGraw Hill, 2002.

PMAE 0070: FOUNDATIONS OF COMPLEX ANALYSIS-I

Course Objectives: To make the students understand the foundations for functions of a complex variable and their applications.

Credits: 04 **Semester I** **L–T–P-J: 4–0–0-0**

Module No.	Contents	Teaching Hours (Approx.)
I	Functions of a complex variable, Spherical representation of complex numbers, Limits, Theorems on limit, Continuous functions, Differentiability, Cauchy-Riemann equations, Polar form of Cauchy Riemann equations, Analytic functions, Harmonic functions. Definite integral, Line integral, Cauchy's theorem, Morera's theorem, Cauchy's integral formula, Higher derivatives, Liouville's theorem, Fundamental theorem of algebra, Maximum modulus theorem. Sequences and Series, Sequences and Series of functions, Power series, Taylor's theorem, Singularities, Laurent's theorem, Residues, Exponential and trigonometric functions, Contour integrations. **Computer Skills:** Introduction to LaTeX and MAPLE, Power point presentation through beamer.	40

Focus: This course focuses on Employability aligned with all CO's

Course Outcomes:

After studying these topics, the students will be able to

CO1: Use the information needed to prove theorems and establish mathematical results.

CO2: Demonstrate the ability to integrate knowledge and ideas of complex differentiation and complex integration in a coherent and meaningful manner and use appropriate techniques.

CO3: Demonstrate the ability to think critically by proving mathematical conjectures and establishing theorems from complex analysis.

CO4: Use Latex in article writing and power point presentation.

Text Books:

- V. Ruel Churchill and J. W. Brown, Complex Variables and Applications, McGraw-Hill Publishing Company, 2013.
- S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 2011.
- H. A. Priestly, Introduction to Complex Analysis, Clarendon Press, 2006
- J. B. Conway, Functions of one Complex Variable, Springer-Verlag, Narosa Publishing House, 1995.
- L. V. Ahlfors, Complex Analysis, McGraw Hill Education, 2017.

Reference Books:

- S. Lang, Complex Analysis, Addison Wesley, 1977.
- M. J. Ablowitz and A. S. Fokas, Complex Variables: Introduction and Applications, Cambridge University Press, 2003.
- W. Rudin, Real and Complex Analysis, Mc Graw Hill Education, 2017.

B.Sc. (HONS.) AGRICULTURE

COURSE CURRICULUM

FACULTY OF AGRICULTURAL SCIENCES

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	BAGC 0103	Fundamentals of Horticulture	1	0	1	2	3
2	BAGS 0101	Fundamentals of Plant Biochemistry and Biotechnology	2	0	1	3	4
3	BAGC 0102	Fundamentals of Soil Science	2	0	1	3	4
5	BAGC 0101	Fundamentals of Agronomy	3	0	1	4	5
6	BAGS 0105	Rural Sociology & Educational Psychology	2	0	0	2	2
7	BAGC 0105	Agricultural Heritage	1	0	0	1	1
8	BAGS 0106	Human Values & Ethics	1	0	0	1	1
9	BAGS 0102	Comprehension & Communication Skills in English	1	0	1	2	3
10	BAGS 0103	Introductory Biology	1	0	1	2	3
11	BAGS 0104	Elementary Mathematics	2	0	0	2	2
12	BAGS 0107	NSS	0	0	2	2	4
13	BAGS 0108	NCC	0	0	2	2	4
14	BAGS 0109	Physical Education &Yoga Practices	0	0	2	2	4
Total			**17**	**0**	**13**	**30**	**43**

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	BAGC 0106	Fundamentals of Genetics	2	0	1	3	4
2	BAGC 0107	Agricultural Microbiology	1	0	1	2	3
3	BAGC 0108	Soil and Water Conservation Engineering	1	0	1	2	3
4	BAGC 0109	Fundamentals of Agricultural Economics	2	0	0	2	2
5	BAGC 0110	Fundamentals of Plant Pathology	3	0	1	4	5
6	BAGS 0110	Fundamentals of Crop Physiology	1	0	1	2	3
7	BAGC 0111	Fundamentals of Entomology	3	0	1	4	5
8	BAGC 0112	Fundamentals of Agricultural Extension Education	2	0	1	3	4
9	BAGS 0111	Communication Skills and Personality Development	1	0	1	2	3
Total			**16**	**0**	**8**	**24**	**32**

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1	BAGC 0113	Crop Production Technology – I (Kharif Corps)	1	0	1	2	3
2	BAGC 0114	Fundamentals of Plant Breeding	2	0	1	3	4
3	BAGC 0115	Problematic Soils and their Management	2	0	0	2	2
4	BAGC 0116	Diseases of Field and Horticultural Crops and their Management – I	2	0	1	3	4
5	BAGC 0117	Farm Machinery and Power	1	0	1	2	3
6	BAGC 0118	Production Technology for Vegetables and Spices	1	0	1	2	3
7	BAGC 0119	Livestock and Poultry Management	3	0	1	4	5
8	BAGS 0112	Environmental Studies and Disaster Management	2	0	1	3	4
9	BAGS 0113	Statistical Methods	1	0	1	2	3
Total			**15**	**0**	**8**	**23**	**31**

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT S HRS/WK
			L	T	P		
1	BAGC 0120	Crop Production Technology – II (Rabi Crops)	1	0	1	2	3
2	BAGC 0121	Production Technology for Ornamental Crops, MAP and Landscaping	1	0	1	2	3
3	BAGC 0122	Agri-Informatics	1	0	1	2	3
4	BAGC 0124	Production Technology for Fruit and Plantation Crops	1	0	1	2	3
5	BAGC 0127	Agricultural Marketing Trade & Prices	2	0	1	3	4
6	BAGC 0125	Principles of Seed Technology	1	0	2	3	4
7	BAGC 0126	Farming System & Sustainable Agriculture	1	0	0	1	1
8	BAGC 0128	Introductory Agro - meteorology & Climate	1	0	1	2	3
9	BAGC 0142	Renewable Energy and Green Technology	1	0	1	2	3
Total			**10**	**0**	**09**	**19**	**27**

Fundamentals of Horticulture: BAGC 0103

Objective: To provide hands on training on various propagation methods and important cultural practices for major fruit and plantation crops.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
1	Horticulture - Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; Plant propagation-methods and propagating structures; Seed dormancy, Seed germination, principles of orchard establishment.	06
2	Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; medicinal and aromatic plants; importance of plant bio-regulators in horticulture.	07
Practical	Identification of garden tools. Identification of horticultural crops. Preparation of seed bed/nursery bed. Practice of sexual and asexual methods of propagation including micro-propagation. Layout and planting of orchard. Training and pruning of fruit trees. Preparation of potting mixture. Fertilizer application in different crops. Visits to commercial nurseries/orchard.	13

Text Books:

1. Jitendra Singh “Fundamentals of Horticulture”, 2020.
2. N. Kumar “Introduction to Horticulture”, 2019.

Focus: This course focuses on Skill Development and Entrepreneurship aligned with **CO1** and **CO2.**

Outcome: After completion of course, the student will be able to:
CO1: Develop nursery management and impart training to others.
CO2: Gain skills about plant propagation and orchard management.
CO3: Learn soil science and fertility management for horticultural crops.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO3, PO4, PO5
CO2	PO1, PO3, PO4, PO5
CO3	PO1, PO4, PO5

Fundamental of Plant Biochemistry and Biotechnology: BAGS 0101

Objective: To provide education that leads to comprehensive understanding of the principles and practices of biochemistry and biotechnology.

Credits: 03 **L-T-P: 2-0-1**

Module No.	Content	Teaching Hours
I	Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and Polysaccharides. Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids. Proteins: Importance of proteins and classification; Structures, titration and zwitter ions nature of amino acids; Structural organization of proteins. Enzymes: General properties; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes. Nucleic acids: Importance and classification; Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure.	13
II	Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain. Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids. Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, another culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation; Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations.	13

Practical	Preparation of solution, pH & buffers, Quantitative estimation of glucose/ proteins. Titration methods for estimation of amino acids/lipids, Effect of pH, temperature and substrate concentration on enzyme action, Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharaides. Sterilization techniques. Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Callus induction from various explants. Micro propagation, hardening and acclimatization. Demonstration on isolation of DNA. Demonstration of gel electrophoresis techniques and DNA finger printing.	13

Text Books:

1. S.S. Purohit "Biochemistry Fundamentals and Applications" 2010.
2. G. Nagaraj "Agricultural Plant Biochemistry" 2020.
3. B. D. Singh "Expanding Horizons of Biotechnology" 2012.
4. B. D. Singh "Biotechnology" 2016.
5. Slater "Plant Biotechnology" 2019.

Focus: This course focuses on Skill Development, Entrepreneurship aligned with **CO1** and **CO2.**

Outcome: After completion of course, the student will be able to:
CO1: Gain knowledge on plant tissue culture for being an entrepreneur.
CO2: Utilize biochemistry and biotechnology skills in crop improvement.
CO3: Learn biotechnological and biochemical approach and their application in agriculture.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4

Fundamentals of Soil Science: BAGC0102

Objective: To impart knowledge and understanding on the composition of earth's crust, soil formation, soil classification, soil properties, soil colloids, and soil pollution.

Credits: 03 **L-T-P: 2-0-1**

Module No.	Content	Teaching Hours
I	Soil as a natural body, pedological and edaphological concepts of soil, Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant growth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth.	13
II	Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; hemic substances - nature and properties; soil organisms: macro and microorganisms, their beneficial and harmful effects; Soil pollution - behavior of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.	13
Practical	Study of soil profile in field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. Study of soil forming rocks and minerals. Determination of soil density, moisture content and porosity. Determination of soil texture by feel and Bouyoucos Methods. Studies of capillary rise phenomenon of water in soil column and water movement in soil. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Study of soil map. Determination of soil colour. Demonstration of heat transfer in soil. Estimation of organic matter content of soil.	13

Text Books:

1. Nyle C Brady and Ray R. Weil, "Nature and Properties of Soil", 2017.
2. Dilip Kumar Das, "Introductory Soil Science", 2011.
3. T. D. Biswas and S. K. Mukherjee, "Textbook of Soil Science", 2017.

Focus: This course focuses on Skill Development and Entrepreneurship aligned with **CO1**, **CO2** and **CO4.**

Outcome: After completion of course, the student will be able to:
CO1: Develop soil fertility management skills.
CO2: Learn skills related to mitigation of soil pollution.
CO3: Acquaint knowledge related to soil microorganism to maintain soil health.
CO4: Develop soil testing laboratory to provide benefit to farmers and to be an entrepreneur.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5
CO4	PO1, PO3, PO4, PO5

Fundamentals of Agronomy: BAGC 0101

Objective: To give the basic knowledge and principles of crop production and soil management.

Credits: 04 **L-T-P: 3-0-1**

Module No.	Content	Teaching Hours
I	Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil-plant water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water, water logging.	20
II	Weeds- importance, classification, crop weed competition, concepts of weed management principles and methods, herbicides- classification, selectivity and resistance, allelopathy. Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.	19
Practical	Identification of crops, seeds, fertilizers, pesticides and tillage implements, study of agro-climatic zones of India, Identification of weeds in crops, Methods of herbicide and fertilizer application, Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill, Study of soil moisture measuring devices, Measurement of field capacity, bulk density and infiltration rate, Measurement of irrigation water.	13

Text Books:

1. Arun Katyayan “Fundamentals of Agriculture Volume-I”, 2000.
2. S.R. Reddy "Principles of Agronomy”, 1999.
3. Arya & Kuril “Principles of Agronomy”, 2017.

Focus: This course focuses on Skill Development aligned with **CO1** and **CO2.**

Outcome: After completion of course, the student will be able to:
CO1: Develop skills for better crop management.
CO2: Develop skills related to operations of agricultural tools in agriculture field.
CO3: Gain knowledge on weed management for production enhancement.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5

Rural Sociology & Educational Psychology: BAGS 0105

Objective – Enhance the knowledge of students about society and their function.

Credits: 02 **L-T-P: 2-0-0**

Module No.	Content	Teaching Hours
I	Sociology and Rural sociology: Definition and scope, its significance in agriculture extension, Social Ecology, Rural society, Social Groups, Social Stratification, Culture concept, Social Institution, Social Change & Development.	13
II	Educational psychology: Meaning & its importance in agriculture extension. Behavior: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.	13

Text Books:

1. Sagar Mandal "Text book of Rural Sociology and Educational Psychology", 2017.
2. J B Chitambar "Introductory Rural Sociology" 2019

Focus: This course focuses on Skill Development aligned with **CO2** and **CO3.**

Outcome: After completion of course, the student will be able to:
CO1: Learn concept of rural sociology and its importance in agriculture.
CO2: Develop skills for positive attitude for rural development.
CO3: Learn techniques for stabilizing and managing micro-project for the upliftment of rural people.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO2, PO3, PO4, PO5
CO2	PO1, PO3, PO4, PO5
CO3	PO1, PO3, PO4, PO5

Human Values & Ethics: BAGS0106

Objective: To develop the ability to distinguish between what is values and what is superficial in life and to enable students to progress from discrimination to commitment.

Credits: 01 **L-T-P: 1-0-0**

Module No.	Content	Teaching Hours
I	Values and Ethics-An Introduction. Goal and Mission of Life. Vision of Life. Principles and Philosophy. Self-Exploration. Self-Awareness. Self-Satisfaction. Decision Making.	06
II	Motivation. Sensitivity. Success. Selfless Service. Case Study of Ethical Lives. Positive Spirit. Body, Mind and Soul. Attachment And Detachment. Spirituality Quotient. Examination.	07

Text Books:

1. Debabrata Basu, Samarpan Chakraborty "Human Values and Ethics", 2019

Focus: This course focuses on Skill Development aligned with **CO1**, **CO2** and **CO3.**

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

CO1: Learn positive attitude, mental satisfaction and selfless service.

CO2: Develop skills related to principles of philosophy, self-exploration, self- awareness and self-satisfaction.

CO3: Evaluate the changes occurred in the thinking, nature and behavior of humans with changing eras.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO3, PO4, PO5
CO2	PO1, PO3, PO4, PO5
CO3	PO1, PO2, PO3, PO5

Comprehension & Communication Skills in English: BAGS 0102

Objective: To acquire the significance of proficiency both in spoken and written language.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond B. Fosdick. You and Your English – Spoken English and broken English G.B. Shaw. Reading Comprehension, Vocabulary- Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to Help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations.	06
II	Functional grammar: Articles, Prepositions, Verb, Subject verb Agreement, Transformation, Synthesis, Direct and Indirect Narration. Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing. Interviews: kinds, Importance and process.	07
Practical	Listening Comprehension: Listening to short talk's lectures, speeches (scientific, commercial and general in nature). Oral Communication: Phonetics, stress and intonation, Conversation practice. Conversation: rate of speech, clarity of voice, speaking and listening, politeness &Reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills. Mock Interviews: testing initiative, team spirit, leadership, intellectual ability. Group Discussions.	13

Text Books:

1. Bodh Raj and Varinder Kumar "Comprehension and Communication Skills in English", 2018.

Focus: This course focuses on Skill Development aligned with **CO1**, **CO2** and **CO3.**

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

CO1: Acquaint English speaking and writing skills.

CO2: Develop formal and informal communication skills.

CO3: Learn English words in general and domain specific context.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO2, PO3, PO5
CO2	PO2, PO3, PO5
CO3	PO2, PO3, PO5

Introductory Biology: BAGS 0103

Objective: To increase understanding of living systems and to allow to consider the systems in relationship to the self and other organisms in the natural environment and to provide application of theory to the real world.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Introduction to the living world, diversity and characteristics of life, origin of life, Evolution and Eugenics. Binomial nomenclature and classification Cell and cell division.	06
II	Morphology of flowing plants. Seed and seed germination. Plant systematic- viz; Brassicaceae, Fabaceae and Poaceae. Role of animals in agriculture.	07
Practical	Morphology of flowering plants – root, stem and leaf and their modifications. Inflorence, flower and fruits. Cell, tissues & cell division. Internal structure of root, stem and leaf. Study of specimens and slides. Description of plants - Brassicaceae, Fabaceae and Poaceae.	13

Text Books:

1. NCERT "Biology", 2019.
2. Cecie Starr, Christine Evers, Lisa Starr "Biology: Concepts and Applications", 2015.

Focus: This course focuses on Skill Development aligned with **CO2.**

Outcome: After completion of course, the student will be able to:
CO1: Acquaint knowledge regarding living beings to better understand with agriculture sector.
CO2: Develop the skills in mounting samples of plant cell and tissues.
CO3: Develop ability to differentiate characters of plant taxonomy.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5

Elementary Mathematics: BAGS 0104

Objective: Read, analyze and write logical arguments to prove mathematical concepts.

Credits: 02 **L-T-P: 2-0-0**

Module No.	Content	Teaching Hours
I	Straight lines: Distance formula, section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two straight lines, Angles between two straits. Lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines, Area of triangle and quadrilateral. Circle: Equation of circle whose center and radius are known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points (x1, y1) & (x2, y2), Tangent and Normal to a given circle at given point (Simple problems), Condition of tangency of a line y = mx + c to the given circle x2 + y2 = a2.	13
II	Differential Calculus : Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity, Differentiation of xn , ex , sin x & cos x from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method and simple problems based on it, Differentiation of Inverse Trigonometric functions. Maxima And Minima of the functions of the formula y=f(x) (Simple problems based on it). Integral Calculus: Integration of simple functions, Integration of Product of two functions, Integration by substitution method, Definite Integral (simple problems based on it), Area under simple well-known curves (simple problems based on it). Matrices and Determinants: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation.	13

Text Books:

1. NCERT "Mathematics", 2012.

Focus: This course focuses on Skill Development aligned with **CO1.**

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

CO1: Develop skills to apply mathematical calculations in agriculture.

CO2: Validate the mathematical knowledge in agricultural statistics.

CO3: Develop analytical knowledge involving mathematical tools.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4

NCC: BAGS 0108

Objective: To develop character, comradeship, discipline, secular outlook, spirit of adventure and ideals of selfless service amongst young citizens.

Credits: 02 **L-T-P: 0-0-2**

Module No.	Content	Teaching Hours
Practical	Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline, Drill- aim, general words of command, attention, stands at ease, stand easy and turning, Sizing, numbering, forming in three ranks, open and close order march and dressing, saluting at the halt, getting on parade, dismissing and falling out, Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, pace forward and to the rear, Turning on the march and wheeling. Saluting on the march, marking time, forward march and halt, Changing step, formation of squad and squad drill, Command and control, organization, badges of rank, honors and awards, Nation Building- cultural heritage, religions, traditions and customs of India. National Integration, Values and ethics, perception, communication, motivation, decision making, discipline and duties of good citizen, Leadership traits, types of leadership. Character/personality development, Civil defense organization, types of emergencies, firefighting, protection, Maintenance of essential services, disaster management, aid during development projects, Basics of social service, weaker sections of society and their needs, NGO's and their contribution, contribution of youth towards social welfare and family planning, Structure and function of human body, diet and exercise, hygiene and sanitation, Preventable diseases including AIDS, safe blood donation, first aid, physical and mental Health, Adventure activities, Basic principles of ecology, environmental conservation, pollution and its control, Precaution and general behavior of girl cadets, prevention of untoward incidents, vulnerable parts of the body, self-defense.	13

Text Books:

1. R. K. Gupta "Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations", 2020

Focus: This course focuses on Skill Development and Employability aligned with **CO1, CO2** and **CO3.**

Outcome: After completion of course, the student will be able to:
CO1: Get reservation in several Government jobs, especially in the Police and paramilitary forces.
CO2: Get academic incentives in many sectors.
CO3: Take part in Republic Day parade at New Delhi.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO2, PO3, PO5
CO2	PO1, PO3, PO4, PO5
CO3	PO2, PO3, PO5

Physical Education and Yoga Practices: BAGS0109

Objective: To teach how to achieve good health, inner peace and harmony by using Yoga, meditation and spiritual development.

Credits: 02 **L-T-P: 0-0-2**

Module No.	Content	Teaching Hours
Practical	Teaching of skills of football- demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit), Teaching of different skills of Football- demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit), Teaching of advance skills of Football – involvement of all the skills in game situation with teaching of rules of the game, Teaching of skills of Basketball – demonstration, practice of the skills, correction of skills, involvement in game situation, Teaching of skills of Basketball – demonstration, practice of the skills, involvement in game situation, Teaching of skills of Basketball – involvement of all the skills in game situation with teaching of rule of the game, Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation, Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation, Teaching of advance skills of Kabaddi – involvement of all the skills in game situation with teaching of rule of the game, Teaching of skills of Ball Badminton – demonstration, practice of the skills, correction of skills, involvement in game situation, Teaching of skills of Ball Badminton – involvement of all the skills in game situation with teaching of rule of the game, Teaching of some of Asanas – demonstration, practice, correction and practice, Teaching of some more of Asanas – demonstration, practice, correction and practice, Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation, Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation, Teaching of skills of Table Tennis – involvement of all the skills in game situation with teaching of rule of the game, Teaching – Meaning, Scope and importance of Physical Education, Teaching – Definition, Type of Tournaments, Teaching – Physical Fitness and Health Education, Construction and laying out of the track and field (*The girls will have Tennikoit and Throw Ball).	13

Text Books:

1. H.L.Khatri “Health, Yoga and Physical Education”, 2015.

Focus: This course focuses on Skill Development aligned with **CO1** and **CO2.**

Outcome: After completion of course, the student will be able to:
CO1: Develop skills necessary to participate in a variety of sports.
CO2: Gain lifelong fitness.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO3, PO5
CO2	PO3, PO5

Fundamentals of Genetics: BAGC 0106

Objective: To know about various genetic principles and their practical implication in crop Improvement.

Credits: 03 **L-T-P: 2-0-1**

Module No.	Content	Teaching Hours
I	Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity. Architecture of chromosome; chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; special types of chromosomes. Chromosomal theory of inheritance- cell cycle and cell division-mitosis and meiosis. Probability and Chi-square. Dominance relationships, Epistatic interactions with example. Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanisms, chromosome mapping.	13
II	Structural and numerical variations in chromosome and their implications, use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance. Genetic disorders. Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.	13
Practical	Study of microscope. Study of cell structure. Mitosis and Meiosis cell division. Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division, Experiments on probability and Chi-square test. Determination of linkage and cross-over analysis (through two-point test cross and three-point test cross data). Study on sex linked inheritance in Drosophila. Study of models on DNA and RNA structures.	13

Text Books:

1. Phundan Singh “Genetics”, 2014.
2. B.D Singh “Fundamentals of genetics”, 2014.

Focus: This course focuses on Skill Development aligned with **CO2.**

Outcome: After completion of course, the student will be able to:
CO1: Acquaint concepts of genetics in the field of agriculture.
CO2: Develop skills in genetics to understand concepts of plant breeding
CO3: Develop the understanding of different principles and their significance in heredity and inheritance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4
CO2	PO1, PO3, PO4
CO3	PO1, PO4

Agricultural Microbiology: BAGC 0107

Objective: To understand the basic microbial structure, function, bio-geochemical cycles, growth requirements of bacteria and production of beneficial bacteria.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Introduction. Microbial world: Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination transformation, conjugation and transduction, Plasmids, transposon.	06
II	Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste.	07
Practical	Introduction to microbiology laboratory and its equipments; Microscope- parts, principles of microscopy, resolving power and numerical aperture. Methods of sterilization. Nutritional media and their preparations. Enumeration of microbial population in soil- bacteria, fungi, actinomycetes. Methods of isolation and purification of microbial cultures. Isolation of Rhizobium from legume root nodule. Isolation of Azotobacter from soil. Isolation of Azospirillum from roots. Isolation of BGA. Staining and microscopic examination of microbes.	13

Text Books:

1. Martin Alexander, “Introduction to Soil Microbiology”, 1967.
2. R. Ananthanarayan and Paniker, “Textbook of Microbiology”, 2017.
3. N. S.Subba Rao, “Soil Microbiology”, 2017.

Focus: This course focuses on Skill Development and Employability aligned with **CO1, CO2** and **CO3.**

Outcome: After completion of course, the student will be able to:
CO1: Develop skills to maintain soil fertility, crop production and human welfare.
CO2: Develop soil testing laboratory and prepare themselves to be employed.
CO3: Develop the skills in utilization of useful microbes to maintain soil health.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO2, PO4

Soil and Water Conservation Engineering: BAGC 0108

Objective: To provide knowledge about soil erosion, water and wind erosion, soil loss equation, management, and conservation practices, water harvesting techniques.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Introduction to Soil and Water Conservation causes of soil erosion. Definition and agents of soil erosion, water erosion: Forms of water erosion. Gully classification and control measures. Soil loss estimation by universal Loss Soil Equation. Soil loss measurement techniques.	06
II	Principles of erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design. Water harvesting and its techniques. Wind erosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion control and its control measures.	07
Practical	General status of soil conservation in India. Calculation of erosion index. Estimation of soil loss. Measurement of soil loss. Preparation of contour maps. Design of grassed water ways. Design of contour bunds. Design of graded bunds. Design of bench terracing system. Problem on wind erosion.	13

Text Books:

1. A.M. Michael, T. P. Ojha, "Principles of Agricultural Engineering Volume II", 2018.
2. R. Suresh, "Soil and water conservation Engineering", 2017.

Focus: This course focuses on Skill Development aligned with **CO2.**

Outcome: After completion of course, the student will be able to:
CO1: Learn the soil and water conservation techniques.
CO2: Develop skills for agronomical measure for controlling soil and water erosion.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4

Fundamentals of Agricultural Economics: BAGC 0109

Objective: to learn about use of economic tools and concepts in the analysis and evaluation of public policies affecting agriculture, food, natural resources, and the environment.

Credits: 02 **L-T-P: 2-0-0**

Module No.	Content	Teaching Hours
I	Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macroeconomics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. Demand: meaning, law of demand, schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process, creation of utility, factors of production, input output relationship. Laws of return: Law of variable proportions and law of returns to scale. Cost: concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, schedule, supply curve, determinants of supply, elasticity of supply.	13
II	Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break-even points. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit. National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socioeconomic determinants, current policies and programs on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, supply, general price index, inflation and deflation. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. Agricultural and public finance: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure. Tax: meaning, direct and indirect taxes, agricultural taxation, VAT. Economic systems: Concepts of economy and its functions, important features of capitalistic,	13

	socialistic and mixed economies, elements of economic planning.	

Text Books:

1. Subba Reddy, P Raghu Ram, TV Neelakanta Sastry and I Bhavani Devi, "Agricultural Economics", 2019.
2. R.K. Lekhi & Joginder Singh "Agricultural Economics: An Indian Perspective", 2015.

Focus: This course focuses on Skill Development and Entrepreneurship aligned with **CO1**, **CO2** and **CO3.**

Outcome: After completion of course, the student will be able to:
CO1: Develop skills regarding business establishment.
CO2: Develop decision-making capabilities to manage risk in business.
CO3: Learn marketing strategies to get employment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO2, PO4, PO5
CO2	PO1, PO3, PO4, PO5
CO3	PO2, PO3, PO4

Fundamentals of Plant Pathology: BAGC 0110

Objective: Teaching basic principles, concepts and terminology of plant pathology and imparting knowledge about the causal agents of plant diseases along with their identification also familiarize with the principles and methods of plant disease management.

Credits: 04 **L-T-P: 3-0-1**

Module No.	Content	Teaching Hours
I	Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Causes / factors affecting disease development: disease triangle and tetrahedron and classification of plant diseases. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiro plasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes. Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of Nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes.	20
II	Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction. Viruses: nature, structure, replication and transmission. Study of phanerogamic plant parasites. Nematodes: General morphology and reproduction, classification, symptoms and nature of damage caused by plant nematodes (Heterodera, Meloidogyne, Anguina, Radopholus etc.) Growth and reproduction of plant pathogens. Liberation / dispersal and survival of plant pathogens. Types of parasitism and variability in plant pathogens. Pathogenesis. Role of enzymes, toxins and growth regulators in disease development. Defense mechanism in plants. Epidemiology: Factors affecting disease development. Principles and methods of plant disease management. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.	19
Practical	Acquaintance with various laboratory equipment's and microscopy. Collection and preservation of disease specimen. Preparation of media, isolation and Koch's postulates. General study of different structures of fungi. Study of symptoms of various plant diseases. Study of representative fungal genera. Staining and identification of plant pathogenic bacteria. Transmission of plant viruses. Study of phanerogamic plant parasites. Study of morphological features and identification of plant parasitic nematodes. Sampling and extraction of nematodes from soil and plant material, preparation of nematode mounting.	13

	Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.	

Text Books:

1. R.S. Singh "Introduction to principles of plant pathology", 2017.
2. H.S. Chaube and V.S. Pundhir "Crop Diseases and their Management", 2009.
3. N.G. Ravichandra "Fundamentals of Plant Pathology", 2013.

Focus: This course focuses on Skill Development aligned with **CO1** and **CO2.**

Outcome: After completion of course, the student will be able to:
CO1: Develop skills related to plant disease management.
CO2: Learn skills related to fungicides formulations.
CO4: Calculate fungicide sprays concentrations for crop protection.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO2, PO5

Fundamentals of Crop Physiology: BAGS 0110

Objective: Basic knowledge of plant physiological and biochemical functions and their importance in crop productivity

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview; Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology; Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms.	06
II	Photosynthesis: Light and Dark reactions, C3, C4 and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown; Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity.	07
Practical	Study of plant cells, structure and distribution of stomata, imbibition's, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, Separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test.	13

Text Books:

1. Singh and Gaurav "Crop Physiology", 2013.

Focus: This course focuses on Skill Development aligned with **CO1.**

Outcome: After completion of course, the student will be able to:
CO1: Develop skills regarding biotic and abiotic stress management.
CO2: Learn physiological growth parameters in crop productivity.
CO3: Acquaint knowledge about morphophysiological characteristics of agricultural crops.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4
CO2	PO1, PO4, PO5
CO3	PO1, PO4

Fundamentals of Entomology: BAGC 0111

Objective: To know about basics regarding morphology, taxonomy, ecology and integrated pest management principles of insects

Credits: 04 **L-T-P: 3-0-1**

Module No.	Content	Teaching Hours
I	History of Entomology in India. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor. Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors– temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors – food competition, natural and environmental resistance. Categories of pests. Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Chemical control importance, hazards and limitations. Recent methods of pest control, repellents, anti-feedants, hormones, attractants, gamma radiation. Insecticides Act 1968- Important provisions. Application techniques of sprayfluids. Symptoms of poisoning, first aid and antidotes.	20
II	Systematics: Taxonomy –importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insectaupto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae;	19

	Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae,Muscidae, Tephritidae.	
Practical	Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper); Dissection of male and female reproductive systems in insects (Grasshopper); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Insecticides and their formulations. Pesticide appliances and their maintenance. Sampling techniques for estimation of insect population and damage.	13

Text Books:

1. K.N. Raghumoorthi, V. Balsubramani, M.R. Srinivasan and N. Natrajan, "Insecta an introduction", 2017.
2. Dhaliwal and Arora,"Integrated Pest management", 2016.

Reference Books:

1. R.E. Snodgrass, "Priniciples of Insect Morphology", 2004.
2. ShadananUpadhyay, "Insect Ecology", 2017.

Focus: This course focuses on Skill Development aligned with **CO2.**

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

CO1: Learn about fundamentals of insect morphology, ecology and the factors affecting the insects.

CO2: Develop skills about various methods of insect-pest management.

CO3: Gain knowledge about integrated pest management for crop improvement.

CO4: Determine insecticides formulations and spray concentrations for crop protection.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4
CO2	PO1, PO4
CO3	PO1, PO4, PO5

Fundamentals of Agricultural Extension Education: BAGC0112

Objective: Develop the skill of students and provide the importance of extension programs in rural development.

Credits: 03 **L-T-P: 2-0-1**

Module No.	Content	Teaching Hours
I	Education: Meaning, definition & Types; Extension Education-meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning Meaning, Process, Principles and Steps in Programme Development. Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (EtawahPilot Project, Nilokheri Experiment, etc.); various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc. Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India. Community Dev.-meaning, definition, concept& principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions.	13
II	Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and social media), media mix strategies; communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.	13

Practical	To get acquainted with university extension system. Group discussion- exercise; handling and use of audio visual equipment's and digital camera and LCD projector; preparation and use of AV aids, preparation of extension literature – leaflet, booklet, folder, pamphlet news stories and success stories; Presentation skills exercise; micro teaching exercise; A visit to village to understand the problems being encountered by the villagers/ farmers; to study organization and functioning of DRDA and other development departments at district level; visit to NGO and learning from their experience in rural development; understanding PRA techniques and their application in village development planning; exposure to mass media: visit to community radio and television studio for understanding the process of programme production; script writing, writing for print and electronic media, developing script for radio and television	13

Text Books:

1. Sagar Mandal "Fundamentals of Agricultural Extension Education", 2018
2. A. K. Singh, Lakhan Singh & R. Roy Burman "Dimensions of Agricultural Extension", 2015.
3. O.P. Dahama O.P Bhatnagar "Education and Communication for Development", 2017

Focus: This course focuses on Skill Development aligned with **CO1, CO2** and **CO3.**

Outcome: After completion of course, the student will be able to:
CO1: Develop skills regarding extension program planning and development.
CO2: Develop decision making capabilities and to strengthen the farmers community.
CO3: Learn various teaching and communication skills to resolve farmers problems.
CO4: Know new trends in agriculture extension.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO2, PO3, PO4
CO2	PO1, PO2, PO3, PO4, PO5
CO3	PO1, PO2, PO3, PO4, PO5
CO4	PO1, PO2, PO3, PO4, PO5

Communication Skills and Personality Development: BAGS 0111

Objective: Become self-confident individuals by mastering inter-personnel skills, team management skills, and leadership skills

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.	07
II	Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, and impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.	06
Practical	Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.	13

Text Books:

1. J.R. Kadam, V.G. Patil, S.A. Dhenge and A.M. Murai "Communication Skills and Personality Development", 2018.

Focus: This course focuses on Skill Development aligned with All **COs.**

Outcome: After completion of course, the student will be able to:
CO1: Organize seminars and conferences.
CO2: Develop formal and informal communication skills.
CO3: Acquaint English speaking, writing skills, abstracting, technical articles, precise writing, abstracting, group presentations and public speaking.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO2, PO5
CO2	PO1, PO2, PO3
CO3	PO1, PO2, PO3, PO5

Crop Production Technology – I (Kharif Corps): BAGC 0113

Objective: To learn about the complete cultivation practices, problems and management for the production of kharif crops.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops. Cereals – rice, maize, sorghum, pearl millet and finger millet,	**07**
II	Pulses-pigeonpea, mungbean and urdbean; oilseed groundnut, and soybean; fiber crops- cotton & jute; forage crops-sorghum, cowpea, cluster bean and napier.	**08**
Practical	Rice nursery preparation, transplanting of rice, sowing of soybean, pigeonpea and mungbean, maize, groundnut and cotton, effect of seed size on germination and seedling vigour of kharif season crops, effect of sowing depth on germination of kharif crops, identification of weeds in kharif season crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of kharif season crops, study of crop varieties and important agronomic experiments at experimental farm. study of forage experiments, morphological description of kharif season crops, visit to research centres of related crops.	**15**

Text Books:

1. Dnyaneshwar Namdev Jagagtap and Uttam Mahadkar "Crop Production Technology-1", 2018
2. Singh, C., Singh, P. and Singh, R., Modern Techniques of Raising Field Crops, CBS, 2020

Focus: This course focuses on Skill Development and Entrepreneurship aligned with **CO2** and **CO3**

Outcome: After completion of course, the student will be able to:
CO1: Learn package and practices of kharif crops and their management.
CO2: Determine weed management techniques for higher crop productivity.
CO3: Develop new and innovative agricultural practices to be an entrepreneur.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5

Fundamentals of Plant Breeding: BAGC 0114

Objective: To improve the genetic makeup of the crop plants by improving yield, quality, disease-resistance, drought and frost-tolerance and important characteristics.

Credits: 03 **L-T-P: 2-0-1**

Module No.	Content	Teaching Hours
I	Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male sterility- genetic consequences, cultivar options. Domestication, Acclimatization and Introduction; Centers of origin/ diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law.	14
II	Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement Schemes Ear to row method, Modified Ear to Row, recurrent selection schemes; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and prebreeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer's Rights.	16
Practical	Plant Breeder's kit, Study of germplasm of various crops. Study of floral structure of self-pollinated and cross-pollinated crops. Emasculation and hybridization techniques in self & cross-pollinated crops. Consequences of inbreeding on genetic structure of resulting populations. Study of male sterility system. Handling of segregation populations. Methods of calculating mean, range, variance, standard deviation, heritability. Designs used in plant breeding experiments, analysis of Randomized Block Design. To work out the mode of pollination in a given crop and extent of natural out-crossing. Prediction of performance of double cross hybrids.	15

Text Books:

1. B.D Singh "Plant Breeding: Principles and Methods", 2015.
2. Phundan Singh "Essentials of plant Breeding". 2014

Focus: This course focuses on Skill Development and Employability aligned with **CO1, CO2** and **CO4.**

Outcome: After completion of course, the student will be able to:
CO1: Develop skills regarding conventional and advanced breeding methods.
CO2: Learn hybrid seed production skills to get an employment in seed industry.
CO3: Learn significance of IPR in crop improvement.
CO4: Distinguish the breeding method for self, cross and asexually propagated crops.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4
CO3	PO1, PO4, PO5
CO4	PO1, PO4

Problematic Soils and their Management: BAGC0115

Objective: To provide knowledge about waste land and problematic soils, their reclamation and management, quality of irrigation water, land capability and suitability classification.

Credits: 02 **L-T-P: 2-0-0**

Module No.	Content	Teaching Hours
I	Soil quality and health, Distribution of Waste land and problem soils in India. Their categorization based on properties. Reclamation and management of Saline and sodic soils, Acid soils, Acid Sulphate soils, Eroded and Compacted soils, Flooded soils, Polluted soils.	07
II	Irrigation water – quality and standards, utilization of saline water in agriculture. Remote sensing and GIS in diagnosis and management of problem soils. Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agro ecosystems.	08

Text Books:

1. L.L Somani, "Textbook of Problematic Soils and their Management", 2017.
2. Nyle C Brady and Ray R. Weil, "Nature and Properties of Soil", 2008.
3. Indian Society of Soil Science, "Fundamentals of Soil Science", 2012.

Focus: This course focuses on Skill Development aligned with **CO1** and **CO4.**

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

CO1: Identify problematic soils, its reclamation and management for soil health.

CO2: Gain basic knowledge to identify multipurpose tree species, bio remediation through MPTs of soils.

CO3: Improve soil fertility and productivity by application of soil test-based macro & micronutrients.

CO4: Develop skills on remote sensing and GIS for the management of problematic soils.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4
CO2	PO1, PO4
CO3	PO1, PO4, PO5

Diseases of Field and Horticultural Crops and their Management-I: BAGC 0116

Objective: Teaching about symptoms, aetiology, disease cycle and management practices of major diseases of *kharif* season field and horticultural crops.

Credits: 03 **L-T-P: 2-0-1**

Module No.	Content	Teaching Hours
I	Symptoms, etiology, disease cycle and management of major diseases of following crops: Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro; Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic;	14
II	Castor: Phytophthora blight;Tobacco: black shank, black root rot and mosaic. Horticultural Crops: Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top;Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight; Cruciferous vegetables: Alternaria leaf spot and black rot; Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: sof rot; Colocasia: Phytophthora blight; Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust	16
Practical	Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for Herbarium; Note: Students should submit 50 pressed and well mounted specimens.	15

Text Books:

1. H.S. Chaube and V.S. Pundhir “Crop Diseases and their Management”, 2009.
2. R.S. Singh “Plant Diseases”, 2018.

Focus: This course focuses on Skill Development aligned with **CO2, CO2** and **CO4.**

Outcome: After completion of course, the student will be able to:
CO1: Learn knowledge to identify symptoms, pathogens involved and disease cycle of *kharif* season crops.
CO2: Learn about detection of disease in field and be able to identify the specific disease and its causal agent.
CO3: Learn about isolation and identification of pathogens in the laboratory and understand their biology.
CO4: Develop skills regarding disease management practices so as to resolve the problem of yield reduction in crops.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5

Farm Machinery and Power: BAGC 0117

Objective: To increase the production and productivity of different crops through farm mechanization and to increase profitability of farmers besides saving in labor and time.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Status of Farm Power in India, Sources of Farm Power , I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines, Study of different components of I.C. engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor,	07
II	Familiarization with Power transmission system : clutch, gear box, differential and final drive of a tractor , Tractor types, Cost analysis of tractor power and attached implement, Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture, implement for intercultural operations, Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.	08
Practical	Study of different components of I.C. engine. To study air cleaning and cooling system of engine, Familiarization with clutch, transmission, differential and final drive of a tractor, Familiarization with lubrication and fuel supply system of engine, Familiarization with brake, steering, hydraulic control system of engine, Learning of tractor driving, Familiarization with operation of power tiller, Implements for hill agriculture, Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow. Familiarization with seed cum-fertilizer drills their seed metering mechanism and calibration, planters and transplanter Familiarization with different types of sprayers and dusters Familiarization with different inter-cultivation equipment, Familiarization with harvesting and threshing machinery.	15

Text Books:

1. Sanjay Kumar “Farm Power and Machinery”, 2018.
2. Donnell Hunt “Farm Power and Machinery Management”, 2013.

Focus: This course focuses on Skill Development aligned with **CO1** and **CO2.**

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

CO1: Develop skills related to working of IC engines and other equipment for crop production.

CO2: Calculate the cost analysis of tractor power and other implements.

CO3: Analyze the operation of farm machinery equipment to evaluate harvesting, threshing and land preparation machinery needed for agricultural farm.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4
CO3	PO1, PO4, PO5

Production Technology for Vegetables and Spices: BAGC 0118

Objective: Teaching the importance and scientific cultivation methods of various vegetable and spice crops.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Importance of vegetables & spices in human nutrition and national economy, kitchen gardening, brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders, of important vegetable and spices (Tomato, Brinjal, Chilli, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas;	07
II	Cole crops such as Cabbage, Cauliflower, Knol-khol; Bulb crops such as Onion, Garlic; Root crops such as Carrot, Raddish, Beetroot; Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak. Perennial vegetables).	08
Practical	Identification of vegetables & spice crops and their seeds. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables & spices. Fertilizers applications. Harvesting & preparation for market. Economics of vegetables and spices cultivation.	15

Text Books:

1. S. Thamburaj "Textbook of Vegetables, Tuber crops and Spices", 2014.
2. Vishnu Swarup, "Vegetable Science and Technology in India", 2006.
3. B. Choudhary, "Vegetables" 2015.

Focus: This course focuses on Skill Development and Entrepreneurship aligned with **CO1** and **CO4**.

Outcome: After completion of course, the student will be able to:
CO1: Develop skills for vegetable cultivation and their management.
CO2: Execute and impart advice on various cultivation practices to the farmers.
CO3: Determine harvesting time and techniques of various vegetables and spices crops, storage conditions and related requirements as per the crops.
CO4: Learn cultivation skills for vegetable and spices being an entrepreneur.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO2, PO4
CO3	PO1, PO4, PO5
CO4	PO1, PO3, PO4

Livestock and Poultry Management: BAGC 0119

Objective – To have expatriation on the housing system, feeding requirements, feeding habits and use of low-cost feed technology for better economic return and to have minimum basic concepts on different disease encountered in the farm animal and poultry and their preventive and control measures.

Credits: 04 **L-T-P: 3-0-1**

Module No.	Content	Teaching Hours
I	Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry. Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry.	21
II	Improvement of farm animals and poultry. Digestion in livestock and poultry. Classification of feedstuffs. Proximate principles of feed. Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives. Feeding of livestock and poultry. Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.	24
Practical	External body parts of cattle, buffalo, sheep, goat, swine and poultry. Handling and restraining of livestock. Identification methods of farm animals and poultry. Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records. Judging of cattle, buffalo and poultry. Culling of livestock and poultry. Planning and layout of housing for different types of livestock. Computation of rations for livestock. Formulation of concentrate mixtures. Clean milk production, milking methods. Hatchery operations, incubation and hatching equipment's. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production.	15

Text Books:

1. Jagdish Prasad "Animal Husbandry and dairy Science". 2018.
2. Jagdish Prasad "Poultry production and management". 2020.
3. G. C. Banerjee "A text book of animal husbandry." 2020.

Focus: This course focuses on Skill Development and Entrepreneurship aligned with **CO1** and **CO4**.

Outcome: After completion of course, the student will be able to:
CO1: Develop skills to establish dairy and poultry being an entrepreneur.
CO2: Learn about management practices for livestock and poultry.
CO3: Develop ability to calculate daily ration of cattle.
CO4: Learn skills for major diseases management of livestock and poultry.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO3, PO4, PO5
CO2	PO1, PO3, PO4
CO3	PO1, PO4
CO4	PO1, PO4, PO5

Environment Studies and Disaster Management: BAGS 0112

Objective: To study about environment, natural recourses, ecosystem, biodiversity, environmental pollution, environmental ethics and disaster management.

Credits: 03 **L-T-P: 2-0-1**

Module No.	Content	Teaching Hours
I	Multidisciplinary nature of environmental studies Definition, scope and importance. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. a) Forest resources: Use and over- exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles. Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega- diversity nation. Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	14
II	Environmental Pollution: definition, cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, and watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acidrain, ozone layer depletion, nuclear accidents and ho locaust. Dies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air	16

	(Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Disaster Management Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.	
Practical	Pollution case studies. Case Studies- Field work: Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/Rural/Industrial/ Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.	**15**

Text Books:

1. Erach Bharucha “Environmental Studies”, 2019.
2. Ranjeet Soni “Environmental Studies and Disaster management”, 2020.

Focus: This course focuses on Skill Development aligned with **CO2** and **CO4.**

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

CO1: Acquire the knowledge of the environment and its various challenges to understand the complex components of the environment.

CO2: Develop the skills in identification of useful natural resources and their management practices.

CO3: Learn disaster management practices to protect natural resources.

CO4: Learn skills for the reduction of pollution impacts on environment.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5
CO4	PO1, PO4

Statistical Methods: BAGS 0113

Objective: To provide knowledge on methods of organizing and simplifying data so that their significance is comprehensible.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation.	07
II	Linear Regression Equations. Introduction to Test of Significance, one sample & two sample test t for Means, Chi- Square Test of Independence of Attributes in 2 ×2 Contingency Table. Introduction to Analysis of Variance, Analysis of One-Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.	08
Practical	Graphical Representation of Data. Measures of Central Tendency (Ungrouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Central Tendency (Grouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Dispersion (Ungrouped Data). Measures of Dispersion (Grouped Data). Moments, Measures of Skewness & Kurtosis (Ungrouped Data). Moments, Measures of Skewness & Kurtosis (Grouped Data). Correlation & Regression Analysis. Application of One Sample t-test. Application of Two Sample Fisher's t-test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2 ×2 contingency table. Analysis of Variance One Way Classification. Analysis of Variance Two Way Classification. Selection of random sample using Simple Random Sampling.	15

Text Books:

1. S. P. Gupta "Statistical Methods",2019.

Focus: This course focuses on Skill Development aligned with **CO2** and **CO3.**

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

CO1: Learn basics of statistics and biostatistics.

CO2: Develop the skills for the use of statistical calculations in agriculture.

CO3: Develop ability to analyze results of statistical calculations and their validation.

CO 4: Develop ability to make statistical hypothesis and design experiment in agriculture

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5
CO4	PO1, PO4, PO5

Crop Production Technology – II (Rabi Corps): BAGC 0120

Objective – To learn about the complete cultivation practices, problems and management for the production of rabi crops

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops; cereals –wheat and barley, pulses-chickpea, lentil, peas,	07
II	Oilseeds-rapeseed, mustard and sunflower; sugar crops-sugarcane; medicinal and aromatic crops-mentha, lemon grass and citronella, Forage crops berseem, lucerne and oat.	08
Practical	Sowing methods of wheat and sugarcane, identification of weeds in *rabi* season crops, study of morphological characteristics of *rabi* crops, study of yield contributing characters of *rabi* season crops, yield and juice quality analysis of sugarcane, and study of important agronomic experiments of *rabi* crops at experimental farms. Study of *rabi* forage experiments, oil extraction of medicinal crops, visit to research stations of related crops.	15

Text Books:

Kushwah and Shailendra Singh "Production Technology of Rabi Crops", 2018

Focus: This course focuses on Skill Development and Entrepreneurship aligned with **CO2** and **CO3.**

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

CO1: Learn production and management techniques in rabi season crops.

CO2: Enhance skill for maintaining the quality of produce.

CO3 Learn modern cultivation practices of high value crops.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5

Production Technology for Ornamental Crops, MAP and Landscaping: BAGC 0121

Objective- To educate on Production Technology for Ornamental Crops, MAPs and Landscaping

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers. Production technology of important cut flowers like rose, gerbera, carnation, lilium and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions.	07
II	Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like ashwagandha, asparagus, aloe, costus, cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver. Processing and value addition in ornamental crops and MAPs produce.	08
Practical	Identification of Ornamental plants. Identification of Medicinal and Aromatic Plants. Nursery bed preparation and seed sowing. Training and pruning of Ornamental plants. Planning and layout of garden. Bed preparation and planting of MAP. Protected structures – care and maintenance. Intercultural operations in flowers and MAP. Harvesting and post-harvest handling of cut and loose flowers. Processing of MAP. Visit to commercial flower/MAP unit.	15

Text Books:

1. Laxmi Lal “Production Technology for Ornamental Crops, MAPs & Landscaping”, 2020.
2. H.C. Srivastava, “Medicinal and Aromatic Plants” ICAR, 2014
3. T.K.bose, “Floriculture and Landscaping” 2014
4. Randhawa and Mukhopadhay, “Floriculture in India”2003
5. J.S.Pruthi, “Plantation Crops” 2016
6. N.Kumar, “Introduction to spices and plantation crops” 2015

Focus: This course focuses on Skill Development, Employability and Entrepreneurship aligned with all **COs.**

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

CO1: Learn various packages of practices for ornamental, medicinal and aromatic plants.

CO2: Develop skills regarding post-harvest handling of cut and loose Flowers.

CO3: Design various layouts of garden and protected structures with their maintenance.

CO4: Impart skills for transferring new and innovative horticultural practices to the farmers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5
CO4	PO1, PO2, PO3, PO4, PO5

BAGC 0122: Agri-Informatics

Objective – To create pool of knowledge, infuse appropriate skills and competence by Agricultural Informatics & e- Governance Systems, for undertaking Science and Technology based interventions in agricultural development.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Introduction to Computers, Operating Systems, definition and types, Applications of MS-Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components. Introduction to computer programming languages, concepts and standard input/output operations'-Agriculture, concepts and applications, Use of ICT in Agriculture.	07
II	Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc., Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc., for supporting Farm decisions. Preparation of contingent crop planning using IT tools.	08
Practical	Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix/ Linux, Creating, Files &Folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data.MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system. Introduction to World Wide Web (WWW). Introduction of programming languages. Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/Wofost; Computation of water and nutrient requirements of crop using CSM and IT tools. Introduction of Geospatial Technology for generating valuable information for Agriculture. Hands on Decision Support System. Preparation of contingent crop planning.	15

Text Books:

1. Jayashankar Pradhan Subrat K Mahapatra, Subrata K Mohanty, Jwel Bhuiya "Introductory Agri-Informatics". 2019.

Focus: This course focuses on Skill Development aligned with **CO2, CO3** and **CO5.**

Outcome: After completion of course, the student will be able to:
CO1: Learn the role and importance of ICT tools in agriculture.
CO2: Develop geospatial technology for generating valuable agri-information.
CO3: Develop computer models to understand plant processes for crop management
CO4: Learn application of decision support systems in Agriculture,
CO5: Develop contingent crop planning using IT tools.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5
CO4	PO1, PO2, PO4, PO5
CO5	PO1, PO4, PO5

Production Technology for Fruit and Plantation Crops: BAGC 0124

Objective: To now importance, different propagation techniques of different fruit and plantation crops.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Importance and scope of fruit and plantation crop industry in India; Importance of rootstocks; Production technologies for the cultivation of major fruits-mango, banana, citrus, grape, guava, litchi, papaya, sapota, apple, pear, peach, walnut, almond.	08
II	Minor fruits- date, ber, pineapple, pomegranate, jackfruit, strawberry, plantation crops-coconut, arecanut, cashew, tea, coffee &rubber.	07
Practical	Seed propagation. Scarification and stratification of seeds. Propagation methods for fruit and plantation crops. Description and identification of fruit. Preparation of plant bio-regulators and their uses, Important pests, diseases and physiological disorders of above fruit and plantation crops, Visit to commercial orchards.	15

Text Books:

1. M Kavino “Production Technology for Fruit and Plantation Crops”, 2018.
2. K.L. Chaddha “Handbook of Horticulture”2019.
3. S.P. Singh “Commercial Fruits” 2018.
4. T.K. Bose, Tropical and Subtropical Fruit crops: Vol 1& 2, 2018.
5. T.K. Chattopadhyay, A Textbook on Pomology Vol.-1,2,3 & 4, 2018.

Focus: This course focuses on Skill Development and Entrepreneurship aligned with all **COs.**

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

CO1: Learn various production and management techniques for fruit and plantation crops.

CO2: Learn plant propagation techniques for quality fruit production.

CO3: Establish nursery of different crops for providing quality planting material.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5

Principles of Seed Technology: BAGC 0125

Objective: To increase high quality seed production its storage and timely supply to the farmers

Credits: 03 **L-T-P: 1-0-2**

Module No.	Content	Teaching Hours
I	Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production, seed quality; Definition, Characters of good quality seed, different classes of seed. Foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables. Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties.	07
II	Seeds Control Order 1983, Varietal Identification through Grow Out Test and Electrophoresis, Molecular and Biochemical test. Detection of genetically modified crops, Transgene contamination in non-GMcrops, GM crops and organic seed production. Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing. Private and public sectors and their production and marketing strategies.	08
Practical	Seed production in major cereals: Wheat, Rice, Maize, Sorghum, Bajra and Ragi. Seed production in major pulses: Urd, Mung, Pigeon pea, Lentil, Gram, Field bean, pea. Seed production in major oilseeds: Soybean, Sunflower, Rapeseed, Groundnut and Mustard. Seed production in important vegetable crops. Seed sampling and testing: Physical purity, germination, viability, etc. Seed and seedling vigor test. Genetic purity test: Grow out test and electrophoresis. Seed certification: Procedure, Field inspection, Preparation of field inspection report. Visit to seed production farms, seed testing laboratories and seed processing plant.	30

Text Books:

1. Dhirendra Khare and Mohan Sadashiv Bhale “Seed Technology”, 2000.
2. Amarjit S. Basra “Handbook of Seed Science and Technology”2010.

Focus: This course focuses on Skill Development, Employability and Entrepreneurship aligned with **CO1**, **CO3, CO4** and **CO5.**

Outcome: After completion of course, the student will be able to:
CO1: Develop seed production skills for field crops and prepare themselves for employment.
CO2: Learn seed storage techniques to minimize post-harvest losses.
CO3: Learn different techniques of varietal identification to maintain purity of seed lots.
CO4: Learn seed testing methods for maintain seed quality.
CO5: Develop skills for detection of transgene contamination in non-GM crops.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO3, PO4, PO5
CO2	PO1, PO4
CO3	PO1, PO4, PO5
CO4	PO1, PO4, PO5
CO5	PO1, PO4, PO5

Farming System & Sustainable Agriculture: BAGC 0126

Objective: To impart knowledge to the students on the fundamentals of farming systems and sustainable agriculture.

Credits: 01 **L-T-P: 1-0-0**

Module No.	Content	Teaching Hours
I	Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance, Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation,	07
II	Conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques, Resource cycling and flow of energy in different farming system, farming system and environment, Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers field.	08

Text Books:

1. SR Reddy "Farming System and Sustainable Agriculture", 2016.
2. R K Nanwal "Farming System and Sustainable Agriculture", 2019.

Focus: This course focuses on Skill Development aligned with **CO1** and **CO2.**

Outcome: After completion of course, the student will be able to:
CO1: Develop skills regarding various methods of farming systems.
CO2: Develop cost effective integrated farming system for different agro-climatic zones.
CO3: Learn conservation agriculture strategies for sustainable farming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4

Agricultural Marketing Trade & Prices: BAGC 0127

Objective: To imparting knowledge of agriculture marketing, different systems, price analysis and trades, finance policy in Agriculture.

Credits: 03 **L-T-P: 2-0-1**

Module No.	Content	Teaching Hours
I	Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets**;** demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; product life cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits; marketing process and functions: Marketing process-concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark).	14
II	Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in Agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.	16
Practical	Plotting and study of demand and supply curves and calculation of elasticity's**;** Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behavior	15

	overtime for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning; Application of principles of comparative advantage of international trade.	

Text Books:

1. Joginder Singh and RL Lekhi "Agricultural marketing trade and prices and India perspective", 2018.
2. S S Acharya and N L Agarwal "Agricultural Marketing in India" 2019.

Focus: This course focuses on Skill Development aligned with **CO2** and **CO3.**

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

CO1: Acquaint the concept of agricultural marketing and demand-supply strategies.

CO2: Develop the skills related to agencies, identification of marketing channels for selected commodity.

CO3: Learn different marketing functions.

CO4: Analyze the marketing channels for different farm products.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

Cos	POs
CO1	PO1, PO5
CO2	PO3, PO5
CO3	PO2, PO3, PO5
CO4	PO2, PO5

Introductory Agro -meteorology & Climate Change: BAGC 0128

Objective: To give knowledge on meteorological parameters and their role on crop production. To know the current climate change scenario and how it's affecting the crop productivity and their mitigation options.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud;	07
II	Precipitation, processor precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking. Monsoon- mechanism and importance in Indian agriculture, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations; Modifications of crop microclimate, climatic normal for crop and livestock production. Weather forecasting-types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture.	08
Practical	Visit of Agro meteorological Observatory, site selection of observatory, exposure of instruments and weather data recording. Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law. Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS. Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis. Measurement of soil temperature and computation of soil heat flux. Determination of vapor pressure and relative humidity. Determination of dew point temperature. Measurement of atmospheric pressure and analysis of atmospheric conditions. Measurement of wind speed and wind direction, preparation of wind rose. Measurement, tabulation and analysis of rain. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.	15

Text Books:

1. Mote and Sahu "Principles of Agricultural Meteorology", 2018.
2. S.R. Reddy, "Principles of Agronomy", 1999.

Focus: This course focuses on Skill Development aligned with **CO2** and **CO4.**

Outcome: After completion of course, the student will be able to:
CO1: Learn role of agrometeorology in agriculture and impact of abiotic factors in crop production.
CO2: Develop skills related to the management of agrometeorological Observatory.
CO3: Learn forecasting techniques for weather and crop planning.
CO4: Learn skills to mitigate effect of climate change and global warming.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5
CO4	PO1, PO4, PO5

Renewable Energy and Green Technology: BAGC 0142

Objective: To facilitate the students to achieve a clear conceptual understanding of technical and Commercial aspects of Wind and Alternative Sources of Energy.

Credits: 02 **L-T-P: 1-0-1**

Module No.	Content	Teaching Hours
I	Classification of energy sources, contribution of these of sources in agricultural sector, Familiarization with biomass utilization for biofuel production and their application, Familiarization with types of biogas plants and gasifiers, biogas, bio alcohol, biodiesel and bio oil production and their utilization as bioenergy resource.	14
II	Introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application, introduction of wind energy and their application.	16
Practical	Familiarization with renewable energy gadgets. To study biogas plants, to study gasifier, to study the production process of biodiesel, to study briquetting machine, to study the production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photovoltaic system: solar light, solar pumping, and solar fencing. To study solar cooker, to study solar drying system. To study solar distillation and solar pond.	15

Text Books:

1. Kothari. Renewal Energy Sources and Emerging Technologies" 2011
2. Kalbande S.R. *et at* "Renewal Energy and Green Technology" 2018

Focus: This course focuses on Skill Development and Entrepreneurship aligned with **CO1** and **CO3.**

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

CO1: Develop skills regarding utilization of biomass for biofuel production at large scale to be an entrepreneur.

CO2: Learn and utilization of solar energy in various aspects.

CO3: Develop skills related to renewable energy resources.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO4, PO5
CO2	PO1, PO4, PO5
CO3	PO1, PO4, PO5

Agricultural Journalism: BAGE 0112

Objective: To prepare students for publishing agricultural news, magazine, articles and stories.

Credits: 03 **L-T-P: 2-0-1**

Module No.	Content	Teaching Hours
1	Agricultural Journalism: The nature and scope of agricultural journalism characteristics and training of the agricultural journalist, how agricultural journalism is similar to and different from other types of journalism. Newspapers and magazines as communication media: Characteristics; kinds and functions of newspapers and magazines, characteristics of newspaper and magazine readers. Form and content of newspapers and magazines: Style and language of newspapers and magazines, parts of newspapers and magazines. The agricultural story: Types of agricultural stories, subject matter of the agricultural story, structure of the agricultural story.	13
2	Gathering agricultural information: Sources of agricultural information, interviews, coverage of events, abstracting from research and scientific materials, wire services, other agricultural news sources. Writing the story: Organizing the material, treatment of the story, writing the news lead and the body, readability measures. Illustrating agricultural stories: Use of photographs, use of artwork (graphs, charts, maps, etc.), writing the captions. Editorial mechanics: Copy reading, headline and title writing, proofreading, lay outing.	13
Practical	Practice in interviewing. Covering agricultural events. Abstracting stories from research and scientific materials and from wire services. Writing different types of agricultural stories. Selecting pictures and artwork for the agricultural story. Practice in editing, copy reading, headline and title writing, proofreading, lay outing. Testing copy with a readability formula. Visit to a publishing office.	13

Text Books:

1. A. K. Singh “Agricultural Extension and farm journalism”, 2019.
2. B.L. Jana “Agricultural Journalism”, 2014.

Focus: This course focuses on Skill Development and Employability aligned with **CO1, CO2** and **CO4.**

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

CO1: Develop writing and reviewing skills related to agriculture sectors.
CO2: Learn legal aspects of news authentication methods.
CO3: Acquaint knowledge regarding editing, copyright and pilgrims.
CO4: Prepare their self to get an employment in various news channels.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

COs	POs
CO1	PO1, PO2, PO3, PO5
CO2	PO1, PO4, PO5
CO3	PO2, PO5
CO4	PO2, PO3, PO5

INSTITUTE OF LEGAL STUDIES AND RESERACH

GLA UNIVERSITY,

MATHURA (U.P.) INDIA

COURSE STRUCTURE

FOR

B.A.LLB. (Hons.)

First Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 0001	1.	Constitutional Law of India – I	4	2	2	6	8
BALC 0002	2.	Law of Torts including MV & Consumer Protection Laws	4	2	2	6	8
BALC 0006	3.	Political Science- 1	4	1	1	5	6
BELH 0010	4.	General English – I	4	1	1	5	6
		TOTAL	**16**	**6**	**6**	**22**	**28**

Second Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 0007	1	Constitutional Law of India-II	4	2	2	6	8
BALC 0005	2.	History(Legal History-I)	4	1	1	5	6
BALC 0004	3.	Sociology(Essentials of Sociology-I)	4	1	1	5	6
BELH 0011	4.	General English – II	4	1	1	5	6
		TOTAL	**16**	**5**	**5**	**21**	**26**

Third Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 0011	1.	Political Science-II	4	1	1	5	6
BALC 0009	2.	Sociology-II	4	1	1	5	6

BALC 1010	3.	History – II	4	1	1	5	6
BCLC 0006	4.	Legal Language & Communication Skills	4	2	2	6	8
		TOTAL	**16**	**5**	**5**	**21**	**26**

Fourth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 1002	1.	Law of Contract-I	4	2	2	6	8
BALC 1001	2.	Jurisprudence-I	4	2	2	6	8
BALC 1003	3.	Family Law-I	4	2	2	6	8
BALC 1106	4.	Political Science: Political System and Governance - I	4	1	1	5	6
		TOTAL	**16**	**7**	**7**	**23**	**30**

Fifth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 2002	1.	Law of Contract-II	4	2	2	6	8
BALC 2001	2.	Jurisprudence-II	4	2	2	6	8
BALC 2003	3.	Family Law-II	4	2	2	6	8
BALC 1005	4.	History – III(European History and the World)	4	1	1	5	6
		TOTAL	**16**	**7**	**7**	**23**	**30**

Sixth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 2004	1.	Interpretation of Statutes	4	2	2	6	8
BALC 1012	2.	Sociology-III	4	1	1	5	6
BALC 2011	3.	Political Science: Political System and Governance - II	4	1	1	5	6
BALC 2005	4.	Legal Hindi	4	1	1	5	6
		TOTAL	**16**	**5**	**5**	**21**	**26**

Four weeks' internship during the academic year except during the class test(s) and the examinations (Total Credit - 02)

Seventh Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 3001	1.	Law of Crimes-I	4	2	2	6	8
BALC 3003	2.	Labour Law-I	4	2	2	6	8
BALC 3002	3.	Property Law & Easement	4	2	2	6	8
BALC 3004	4.	Political Science – (Public Administration)	4	1	1	5	6
		TOTAL	**16**	**7**	**7**	**23**	**30**

Eighth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 4001	1.	Law of Crimes-II	4	2	2	6	8
BALC 4003	2.	Labour Law-II	4	2	2	6	8
BALC 4002	3.	Administrative Law	4	2	2	6	8
BALC 4004	4.	Political Science- VI	4	1	1	5	6
		TOTAL	**16**	**7**	**7**	**23**	**30**

Ninth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 4005	1.	Criminal Procedure Code- I	4	2	2	6	8
BALC 4006	2.	Civil Procedure Code-I	4	2	2	6	8
BALC 4007	3.	Company Law	4	2	2	6	8
BALC 4008	4.	Laws of Taxation	4	2	2	6	8

		TOTAL	**16**	**8**	**8**	**24**	**32**

Four weeks' internship during the academic year except during the class test(s) and the examinations (Total Credit - 02)

Tenth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 5005	1.	Criminal Procedure Code - II	4	2	2	6	8
BALC 5006	2.	Civil Procedure Code-II	4	2	2	6	8
BALC 5007	3.	Public International Law	4	2	2	6	8
BALC 5008	4.	Environmental Law	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Eleventh Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 6001	1.	Law of Evidence- I	4	2	2	6	8
BALC 6002	2.	Sports Law	4	2	2	6	8
BALC 6003	3.	Anti-Corruption Money Laundering Laws	4	2	2	6	8
BALC 6004	4.	Cyber Law	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Twelfth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		

	1.	Law of Evidence- II	4	2	2	6	8
	2.	Elective- III	4	2	2	6	8
	3.	Elective- IV	4	2	2	6	8
	4.	Honours-II	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Four weeks' internship during the academic year except during the class test(s) and the examinations (Total Credit - 02)

Thirteenth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
	1.	Elective- V	4	2	2	6	8
	2.	Elective- VI	4	2	2	6	8
	3.	Honours-III	4	2	2	6	8
	4.	Honours-IV	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Fourteenth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
	1.	Honours- V	4	2	2	6	8
	2.	Honours-VI	4	2	2	6	8
	3.	Clinical-I (Drafting's&Pleadings)	4	2	2	6	8
	4.	Clinic-II (Alternative Dispute Resolution)	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Four weeks' internship during the academic year except during the class test(s) and the examinations (Total Credit - 02)

Fifteenth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
	1.	Honours- VII	4	2	2	6	8
	2.	Honours-VIII	4	2	2	6	8
	3.	Clinical-III (Professional Ethics)	4	2	2	6	8
	4.	Clinical-IV (Moot Court)	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Honour's Courses

1. **Constitutional Law**
   - H-I Legal and Constitutional History of India
   - H-II Comparative Constitution,US, India and UK
   - H-III Local Self-Governments, Gram Panchayat and Municipal Administration
   - H-IV Law on Education and Religion
   - H-V Right to Information
   - H-VI Legislative Drafting
   - H-VIIIIndian Federalism and Judicial Independence
   - H-VIII Election Laws

2. **Corporate & Business Law Group**
   - H-I Law of Aviation
   - H-II Domestic Insurance Law
   - H-III Law of Mergers and Acquisitions
   - H-IV International Contracts Law
   - H-V Cyber Law
   - H-VI Intellectual Property Law
   - H-VII Alternative Dispute Resolution

H-VIII Banking Law

3. **International Law**
   - H-I Law relating to Regional Trade Agreements
   - H-II Tran boundary Exports, Imports and Anti-dumping Law
   - H-III WTO and GATS
   - H-IV Law of the Sea
   - H-V Law of the Aviation
   - H-VI International Environmental Law
   - H-VII International Labor Organization and Labor Law
   - H-VIII International Criminal Law and Criminal Court

4. **Intellectual Property Rights**
   - H-I Evolution IPR Treaties and Convention
   - H-II Copyright Law
   - H-III Law of Patents
   - H-IV Law of Trademarks and Service Marks
   - H-V Traditional Knowledge, GI and Farmer Rights
   - H-VI Other Intellectual Property
   - H-VII IPR Valuation and Management
   - H-VIII IPR Protection and Technology

ELECTIVE COURSES

Elective - I

- Citizenship & Emigration Law
- Legislative Practices and procedures in India

Elective - II

- Private International Law
- International Business Dispute Resolution Mechanisms.

Elective-III

- Competition Law
- Criminology and Penology

Elective-IV

- Comparative Criminal Law
- Law of Infrastructure Development and Real Estate

Elective-V

- Media Law
- Trust, Equity and Fiduciary Relationships

Elective-VI

- International Commercial Arbitration
- Right to Information and Public Accountability

NOTE: 1. Any of the Honours/Elective subjects may not be offered to the students if the teaching facility for such a subject is not available or does not exist at IUD campus.

2. No student shall be allowed to change his/ her honours/Elective subject except during the two weeks of commencement of teaching.

BALC 1001: CONSTITUTIONAL LAW OF INDIA- I

OBJECTIVE:

The objective of this paper is to provide the understanding of fundamental rights and duties, perspective and remedies. Students will be able to understand the nature of the State, relationship between Fundamental rights and Directive Principles of State Policy.

Credits: 06 **Trimester I** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
Module-I	Characteristics of the Indian Constitution. Special emphasis shall be placed on (A) Federal Structure and (B) form of Government. **Preamble.** Fundamental Rights-General Scheme of fundamental Rights, who can claim fundamental rights: Against whom fundamental rights are available? Suspension of fundamental Rights. Definition of 'State' for enforcement of fundamental rights: Justifiability of fundamental Rights. Doctrine of Eclipse, Severability, Doctrine of Waiver.(Art.12 &13) Right to Equality (Arts-14-18): Doctrine of Reasonable classification and the principles of Absence of Arbitrariness, Principle of compensatory discrimination. Fundamental freedom (Article 19): Freedom of Speech and Expression (a) Freedom of press.Art.19 (1)(a).	**30**
Module-II	Fundamental Rights – Double Jeopardy, Right to Life and Personal Liberty, Protection against Illegal Arrest and Detention (Articles20,21,22): Scope and content (Expensive Interpretation-Right to Privacy, Live in Relationships etc) Right against exploitation (Article 23-24): Forced Labour, Child Employment and Human Trafficking. Freedom of Religion and Cultural Educational Right of Minorities(Art. 25-30), Right to Constitutional Remedies: - Writs Habeas corpus, mandamus, certiorari, prohibition and Quo-Warranto, Art. 32 and 226, Judicial Review. Directive Principles. Art. (37-51)-Nature and Justifiability of the Directive Principles. Inter-Relationship between Fundamental Rights and Directive Principles. Fundamental Duties.(Art.51A), Amendment of the constitution. Power and Procedure, Basic Structure of the Constitution.(Art.368)	**30**

REFERENCE BOOKS:

- D.D. Basu, Shorter Constitution of India, 15th Edition 2018, Lexis Nexis, Nagpur
- Shukla, V.N., Constitution of India, Lucknow: Eastern Book Co.
- J.N. Pandey, Constitution of India., 47th Edition., Central Law Agency, 2014.
- P.M. Bakshi, Constitution of India. 12th Edition., Universal Publishing House, 2013.
- M.V. Pylee, Constitutional Government in India, Asia Publishing House.
- Seervai H.M. Constitutional Law of India.
- M.P. Jain, Constitutional of India, Wadhwa Nagpur.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Students will be able to understand the philosophy of Fundamental Rights in the supreme law of land and its enforcement

CO2: Understand the process of issuance of different writs.

CO3: Understand amending power of parliament of Constitution.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**

CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

BALC 0002: LAW OF TORTS INCLUDING MV AND CONSUMER PROTECTION LAWS

Objective:*Tort is a civil wrong, i.e. a legally harmful act or omission. The course aims at introducing the law of tort to the student so that the student can take it up for practice or further study.*

Credits: 06 **L-T-P: 5-1-0**

Semester I

Module No.	Content	Teaching Hours
I	Tort, Nature and Definition of Torts, Tort and Crime, Tort and Contracts, Tort and Breach of Trust, Elements of Tort, Mental Element in Tort, Malice in Law and Malice in Tort, Misfeasance and Malfeasance, Foreign Torts. General Defences, Capacity, Vicarious Liability.	20
II	Death in Relation to Torts, Discharge of Torts, Remedies, Torts Against Person, Defamation, Malicious Prosecution, Torts against Property, Negligence, Nuisance, Liability	20
III	Consumer Protection Act: Aim and objective of the Act, Definition, Rights of consumer, Consumer Protection Council, Complaints and process of making Complaints, Composition, Power, Function and Jurisdiction of consumer Disputes, Redressal Agencies, Reliefs. Motor Vehicle Act, 1988: Objects and Reason, Definitions, Licensing of Drivers of Motor Vehicle Registration of Motor Vehicles, Liability without fault in certain cases, Insurance of Motor Vehicle against third Party risk	20

Recommended Readings

- Singh, P. S. A.Pillai's Law of Tort (Lucknow: EBC, 2010).
- C. Walton, ed., Charlesworth & Percy on Negligence (London: Sweet & Maxwell, 2011)
- D. G. Owen, The Philosophical Foundations of Tort Law (London: OUP, 1999).
- F V Robert and R. A. Buckley, Salmond and Houston on the Law of Torts (London: Sweet & Maxwell, 1996).
- J. Murphy, The Law of Nuisance (London: OUP, 2011).
- P.A. Dugdale, Clerk & Lindsell on Torts (London: Sweet & Maxwell, 2011).

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Know the principles of tort and its implication.

CO2: Acquainted with the knowledge of about tortious liability.

CO3: Gain knowledge of different kinds of tortious liability and will be aware about their civil rights.

CO4: Understand the rights and duties of consumer and about the consumer jurisdiction and forum.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 0005: HISTORY-I (LEGAL HISTORY)

Objective*:* *The primary objective of this paper is to answer the question how and why the present has evolved from the past in the manner it has. It is important to understand both historiography and historical methodology. A study of the nature of the state and administrative apparatus is required for proper understanding of the legal systems in ancient and medieval India.*

Credits: 06 **L-T-P: 5-1-0**

Semester I

Module No.	Content	Teaching Hours
I	History and Law: Relevance of History to Law, Interdisciplinary Approach, Rethinking History and Historian's Craft, Indian Historiography, Orientalist, Utilitarian's, Nationalists, Marxist, Religious Nationalist, Subalterns and Regional Histories. Ancient India: State, Polity and Governance. Nature of State, Notions or Kingship (Brahminic, Buddhist, Kautalyan), and administrative apparatus in Vedic Age, Age of Mauryas and Guptas, Kinship, Caste and Class, Social Differentiation, Family, Patriliny. Rules of Marriage, Gotra, Jatis and Varnas, Access to Property and Gender, Religious Traditions and Polity, Brahminism, Buddhism, Jainism.	20
II	Medieval India: Kings and their Courts, Cholas, Local Self-Government, Delhi Sultanate, Theory of Kingship (Balban), Administrative Apparatus, Vijayanagara State, Mughals, Theory of Sovereignty (Akbar), Administrative Structure. Bhakti-Sufi Tradition in relation with the State and Reconfiguration of Identity, Peasant, Zamindars and the State, Market Reforms of Alauddin Khilji, Agrarian Reforms of Akbar.	20
III	The Concept of Justice and Judicial Institutions in Ancient and Medieval India: Sources of Law in Ancient India, Concept and Sources of Dharma, Veda, Dharmasutra, Dharma Shastra, Tradition and Good Custom, Types of Courts and Procedures b. Legal Thinkers of Ancient India, Manu and Yajnavalkya c. Legal Traditions in Medieval India, Sources of Islamic Law (Quran, Hadis, ljma, Qiyas), Salient Features of Islamic Criminal Law, Hanafi School of Thought.	20

Recommended Readings

- H.V. Sreenivasa Murthy - History of India, Eastern Book Company, 2011.
- E.H. Carr, What is History, Penguin, 2008 Edn.
- Sabyasachi Bhattacharya (ed.) Approaches to History, Essays in Indian Historiography, Primus Books, 2013.
- T. Rama Jois. Legal and Constitutional History of India, Ancient Legal, Judicial and Constitutional System, Universal Law Publishing Co. 2004 (Reprint).
- A.L. Basham, The Wonder that was India, Part-I, Rupa& Co., 1993 (20th Edn)
- S.A.A. Rizvi, The Wonder that was India, Part -II, Sedgwick & Jackson, 1987, Prakash Books 2004

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Relate with the evolution of the legal systems in ancient and medieval India.
CO2: Study the nature of the state and administrative apparatus
CO3: Understand both historiography and historical methodology.
CO4: Answer the question, how and why the present has evolved from the past in the manner it has.

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

Mapping of Programme Educational Objectives with Course Outcomes
A broad relation between the Programme Objective and the outcomes is given in the following table:

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes
A broad relation between the Program Specific Objectives and the outcomes is given in the following table:

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 0004: SOCIOLOGY-I (ESSENTIALS OF SOCIOLOGY)

Objective: *The aim is designed to familiarize the student with the historical background of the subject and certain relevant basic concepts.*

Credits: 06 **L-T-P: 5-1-0**

Semester I

Module No.	Content	Teaching Hours
I	Sociology: Definition, origin, nature and scope of the subject Sociology as a science, Data, concepts and theory, Methods and techniques used in Social Research Sociology and other Social Sciences: Relation with History, Psychology, Economics, political Science etc.	20
II	Basic Concepts in Sociology: Society, Community, Association and Institutions, Structure and Function, Status and Role Norms and Values, Socialisation, Culture and Social Processes Social Institutions: Marriage, Family and Kinship, Economic Institutions, Political Institutions, Religious Institutions, Educational Institutions	20
III	Social Stratification: Caste and class, Social control, order and stability, Coercion, Conflict and Change Sociology as discipline. Law and Society: Sociology of Law, Sociology of Legal Profession.	20

Recommended Readings

- T. B. Botomore, Sociology, A Guide to Problems and Literature, London Allen and Unwin 1962.
- Hary M. Johnson, Sociology -A Systematic Instruction.
- Maclver and Page, Sociology.
- Peter Worsley et al, Introducing Sociology, Harmondsworth, Penguin Books 1970

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Relate with the evolution of the legal systems in ancient and medieval India.
CO2: Integrate sociological theory, research, and data in order to assess various explanations of social phenomena and to assess social policy.
CO3: Critically analyze classical and fundamental sociological theories of Kar Marx and Max Weber to understand the Sociology of Law.
CO4: Understand the historical and socio-economic background of the Sociology and its scope and techniques for social research.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	PROGRAMME EDUCATIONAL OBJECTIVE			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	PROGRAM SPECIFIC OBJECTIVES			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BELH 0001: GENERAL ENGLISH- I

Objective*:* *The course aims at familiarizing the students with English language sound system to enhance their power of articulation. It provides intensive practice and extensive exposure to listening, speaking, reading and writing skills. It would enhance not only their comprehensive knowledge of vocabulary but also strengthen their all four skills. The design and content of the course are aimed at making students gain language proficiency and also to improve their communication skills.*

Credits: 06 **L-T-P: 5-1-0**

Semester I

Module No.	Content	Teaching Hours
I	Basics of Communication: The channels/ networks, forms, factors and process of Communication, Verbal & Non-Verbal Communication techniques, Body Language and its various forms, Barriers to Communication, types and ways to overcome them. Art of Conversation: Participate well in the art of conservation, qualities of a good conversationalist, Practice the voice modulation techniques using appropriate body language. English Language Phonetic System: Sound system classification and features, Syllable Structure, acquire correct pronunciation & accent by overcoming specific speech problems. Reading Skill: The mechanics, techniques and types of Reading, Develop the ability to infer and interpret the text, Know the traits of reading to improve speed and vocabulary. Listening Skill: Know the importance and techniques of improving listening skill, Cognitive process, Homophones and Homonyms, learn how to overcome the Listening barriers.	20
II	Vocabulary Extension: Learn to identify and convey the finer shades of meaning with accuracy, Synonyms, Antonyms, and one-word substitutes, Practice the methods of Vocabulary expansion, Word formation and word analysis techniques, Commonly confused words, Legal Terminology. Grammar: Subject, Verb agreement, Tenses and their forms, Acquire the ability to analyse the sentence syntactically. Prepositional Phrases: Know the various relationships expressed by specific use of Prepositions, Develop the competence in using idiomatic combinations, use correct Preposition after a verb, adjective and noun depending on the meaning. Phrasal Verbs: Separable & Inseparable, Learn the several verb combinations with distinct meanings, Practice using Phrasal Verbs effectively.	20
III	Effective Use of Words & Sentences: Understand the principles to be applied in selecting words, identify redundancy and learn to avoid cliché and vague words, Express the ideas clearly by using words effectively, Sentence structure and types. Subordination & Coordination, Active & Passive, Parallel Constructions, and Principles of constructing effective sentences. Effective Paragraphs: Principles of Effective Paragraphs Learn how to build Effective Paragraphs through Unity, Coherence and Emphasis, Acquire the skill of writing effectively. Business Correspondence: Business Letters: Structure, Components	20

	and Formats. Types of Business Letters and their essential features, Develop the skill of drafting Enquiry letters, Quotation letters, Order letters, Acknowledgement letters, Cover letters, etc., Learn effective beginnings and closings of these letters, Gain proficiency in writing business letters concisely, naturally, clearly and positively. Oral Presentations: Learn how to prepare the Presentations, know how to master the various techniques of effective speech delivery along with practice, learn how to manage question & answer session.	

Recommended Readings

- Aruna K. Dr., Professional Communicator, Tata McGraw, Hill Education Private Limited, 2008.
- Hornby A.S., Oxford Advanced Learner's Dictionary. Oxford University Press.
- Daniel Jones, Cambridge English Pronouncing Dictionary. Cambridge University Press.
- Quirk R. Greenbaum S., Leech G. and Svartik J., A Comprehensive Grammar of the English Language, Longman, London.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Use grammar rules in English conversation.

CO2: Learn the art of conversation with English Language Phonetic System.

CO3: Learn basic skills for written and oral communication in English.

CO4: Understand the commerce and trade activities in the society.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	PROGRAMME EDUCATIONAL OBJECTIVE			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	PROGRAM SPECIFIC OBJECTIVES			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 2001: JURISPRUDENCE-II (INDIAN LEGAL SYSTEM)

Objective*:* *The Indian legal system represents Indian laws, judicial institutions and legal traditions. The course introduces the Indian legal system to the student preparatory to studying particular branches of law.*

Credits: 06 **L-T-P: 5-1-0**

Semester II

Module No.	Content	Teaching Hours
I	The concept of legal system and main types of legal systems in the world, Nature and functions of a legal system. Legal system in the ancient India: The Hindu period, Legal system in the medieval India: The Mughal period, origin of the modern Indian legal system: The colonial period, the Mayors Courts: Genesis, working, defects, The Adalat System: Grant of Diwani, execution of Diwani, functions, reorganization of Adalats in 1780, the first civil code, reforms in the administrations of criminal justice.	20
II	Supreme Courts at Calcutta, Madras and Bombay: Law and administration of justice. Establishment of the High Courts: The Indian High Courts Act 1861. Allahabad High Court the Indian High Courts ACL 1911, the Government of India Act 1915: Other High Courts, Government of India Act 1935: Jurisdiction of High Courts, post-constitutional developments. The Federal Court of India: Establishment of the Federal Court, jurisdiction, authority of law, expansion of jurisdiction, abolition of the Federal Court: Functioning and evaluation	20
III	Privy Council: Jurisdiction, appeals from India, evaluation, The Supreme Court of India: Origin, appointment of judges, jurisdiction and powers, doctrine of precedent, evaluation, Indian legal profession: British legacy, salient features of the Advocates Act, 1961, evaluation, Nyaya Panchayat in India: Rationale, the Gram Nyayalayas Act, 2008. functioning and evaluation, Lok Adalat in India: Rationale, functioning and evaluation, Legal aid in India: Constitutional basis, the Legal Services Authorities Act, 1987, object and reasons, evaluation, Contemporary issues: Judicial reforms: Judicial appointments, procedural transparency: E-filing and live telecast of court hearings, measures to curb systemic delays, judicial accountability	20

Recommended Readings

- B. Abel-Smith and R. Stevens, Lawyers and the Courts (London: Heinemann, 1967).
- J. A. G. Griffith, The Politics of the Judiciary (London: HarperCollins, 1997).
- J. D. M. Derrett, An introduction to Legal Systems (New Delhi: Universal, 2011).
- J. Minattur, Indian Legal System (New Delhi: Oceana Publications, 2006).
- J. Raz, The Concept of a Legal System (London: OUP, 1980).
- K, Malleson and R. Moules, The Legal System (London: OUP, 2010).
- M. Hidayatullah, Democracy in India and Judicial Process (New Delhi: Asia Publishing 1966).

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Adopt a pragmatic approach in studying law.

CO2: Read, analyse and understand legal writings, and to narrate the reasoning employed by judges in their judgements

CO3: Discuss the important the fundamental concepts underlying the Indian law

CO4: Distinguish between the different types of laws

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 0011: POLITICAL SCIENCE-II (WESTERN POLITICAL THOUGHTS)

Objective*:* *This paper focuses on understanding the forms that governments acquire along with the nature and conflicts encountered by different forms of governments. Students would get trained to look into centre- state conflicts and legislature-executive-judiciary conflicts. The design is to look into how emerging issues in international relations become important in the legal context and prepare the students to understand International Law.*

Credits: 06 L-T-P: 5-1-0

Semester II

Module No.	Content	Teaching Hours
I	Concept: Concept of Power, Authority and Legitimation. Legitimacy of power: The classical (Hobbes, Locke and Roousseau) and modern (Max Webber, Karl Marx and Durkheim) approaches to the notion of political obligation.	20
II	Utilitarianism: Utilitarianism (both rule and act utilitarianism) as approaches to political obligation. The problem of civil disobedience and political obligation with special reference to Gandhian	20
III	Neo-Gandhian thought: The problem of obedience to unjust laws. Foundations of promissory and contractual liability. The problem of punishment: Use of force by State against the citizen (the basis of criminal sanction) -- The contemporary origin of legitimation.	20

Recommended Readings

- Kothari Rajani, Democratic Policy and Social Change in India: Crisis and Opportunities., Allied Publishers, 1976.
- Kari Lowernastein, Political Power and the Government Process.
- Nishet R.A., The Sociological Tradition, 1967.
- Bierstedt Robert, Power and Progress, 1974 (MC Graw-Hill).
- Leiser: Liberty, Justice and Morals (Ch.12 - Civil Disobedience).
- George Lich Theim: A Short History of Socialism, 1976.
- Drench Green: Principles of Political Obligation and Political Theory.

Focus: This course focuses on skill development aligned with all Cos
Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Prepare the students to understand International Law.

CO2: Look into how emerging issues in international relations become important in the legal context.

CO3:Analyze into center-state conflicts and legislature-executive- judiciary conflict.

CO4:Understand the forms of government along with the nature and conflicts encountered by different forms of governments.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 0009: SOCIOLOGY-II (SOCIETY IN INDIA)

Objective*:* *The paper formally introduces the student to the key issues around which the everyday life in India is constructed.*

Credits: 06 **L-T-P: 5-1-0**

Semester II

Module No.	Content	Teaching Hours
I	Study of Indian Society: The Development of Indian Society, Unity and Diversity, Continuity and Change Ancient. Medieval and Modern, Rural and Urban Characteristics. Indian as Plural Society: Varieties of Cultural Diversities, Linguistic Religious, Political, Economic and Cultural Communities.	20
II	Major Institutions of Indian Society: Family, Marriage, Caste, Village, Tribe and Caste in the Traditional Order, Caste and Class in contemporary India, the backward classes.	20
III	Indian Cultural values and developments: Impact of Muslims and British cultures, Trend of change in Indian Society, Rural and Urbanization, Industrialization, Modernization, Globalization.	20

Recommended Readings

- Bose. K. N, The Structure of Hindu Society, New Delhi, Orient Longman, 1975.
- Andre Beteille, The Backward Classes and the New Social Order, Delhi, Oxford University Press. 1981.
- Romesh Thappar (ed), Tribe, Caste and Religion in India, New Delhi, Macmillan, 1977
- Desai A.R, Rural Sociology
- M. N. Srinivas, Caste in Modern India
- M.N. Srinivas, Social Change in Modern India
- Odhum and Meinkoff, A Hand Book of Sociology
- K.M., Marriage and Family India
- Government of India Publication, Social Legislation

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Understand the different dimension of social movements.
CO2: Critically analyze how the law can change society.
CO3: Understand the sociological school of law
CO4: Conceptualize how social problems which can be addressed in the framework of the Law.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 0006: LEGAL LANGUAGE AND COMMUNICATION SKILLS

Objective:*Legal English communicates legal meaning in the English language. The course aims at helping the students understand legal English and acquire the skills of communication in legal English.*

Credits: 06 L-T-P: 5-1-0

Semester II

Module No.	Content	Teaching Hours
I	Communication: Meaning, development and approaches, forms of communication: oral and written, passive and active listening, the role of communication. The relation of Law to language: meaning and explanation with reference to relevant legal texts, origin of legal English: Examples from Latin: Legal Maxims.	20
II	Growth of legal English: Introduction to the legal and Constitutional history of England, The emergence of plea roles and law reports, manifestations of legal English: Legal terminology: Examples from legal texts: Constitution, Statues, treaties, Judgments, Characteristics of legal English: Legal usage: Examples from legal texts. Identifying legal English communication: class exercise from legal texts: Constitution, statutes, treaties, judgments	20
III	Understanding of legal English Communication: Explanation of legal words and phrases from the discussion of legal texts: Constitution, Statutes, judgments, The importance of communication in legal profession: Discussion of landmark pleadings and legal briefs, Discussion of landmark judgments and advisory opinions: Class exercise: Mock pleadings, judgments and legal briefs writing, Simplifying legal English communication: Analysis of legislation and judgments and class exercise, The role of grammar, Legal writing exercises.	20

Recommended Readings

- A. Marmor and S. Soames, Philosophical Foundations of Language in (London: OUP, 2011).
- B. Bix, Law, Language and Legal Determinacy (London: OUP, 1995).
- B. Garner, Garner's Dictionary of Legal Usage (London: OUP, 2011).
- C. Williams, Tradition and Change in Legal English (New York: Peter Lang, 2005)
- E. Finch and S. Falinski, Legal Skills (London: OUP, 2011).
- E. Mertz, The Language of Law School (London: OUP, 2007).
- F. W. Maitland, The Constitutional History of England (NewDelhi: Vikas, 1987).

Focus: This course focuses on skill development aligned with all Cos

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	PROGRAMME EDUCATIONAL OBJECTIVE			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	PROGRAM SPECIFIC OBJECTIVES			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 0007: CONSTITUTIONAL LAW OF INDIA- II

Objective*:* The students will be abreast of foundation philosophy of Constitution, nature and working of the Constitution, source of powers. The course will enable the students to critically evaluate and scrutinize the various provision of the Constitution of India.

Credits: 06 **Semester II** **L-T-P: 5-1-0**

Module No.	Content	Teaching Hours
Module-I	. **Union Parliament**: organization, Qualification for membership of parliament, Duration, powers. Privileges of its members. Procedure regarding enactment of Legislation. **Union Executive: The president**- his Position and powers including ordnance marking Power and to grant pardon etc. **Governor:** Appointment, Qualification, terms off office and powers including ordinance making power and to grant pardon, etc. **Prime Minister and cabinet:** Is the Prime Minister real head? Council of ministers? Collective Responsibility.	**30**
Module-II	**Union Judiciary:** Appointment of Judge transfer, removal, Promotion Independence of Judiciary. **Jurisdiction:** Original, Appellate, Advisory, Court of record, Judicial review. **State Judiciary:** Appointment of Judge of High Court , Transfer, Removal Promotion, Jurisdiction. **Distribution of powers between centre and States:** Legislative, Administrative and Financial Relationship between union and the states. Territorial and topical distribution of powers of Parliament to legislate on the state matters. Doctrine of Territorial nexus, doctrine of pith and Substance, Doctrine colourable legislation. **Emergency Provision:** With special reference to proclamation of National emergency and President Rule. **Freedom of Trade, Common and Intercourse.**	**30**

REFERENCE BOOKS:

- D.D. Basu, *Shorter Constitution of India* 15th Edn. 2018, Lexis Nexis, Nagpur
- Shukla V.N. *Constitution of India*, Lucknow: Eastern Book Co.

- J.N. Pandey, *Constitutional Law of India* 47th Edn. Central Law Agency, 2014
- P.M. Bakshi *Constitution of India* 12th Edn. Universal Publishing House. 2013
- M.V. Paylee *Constitution Government in India*, Asia Publishing House
- Seervai H.M. *Constitutional Law of India*.
- M.P. Jain Constitution of India. Wadhwa Nagpur
- Glanville Austin, Indian Constitution- Cornerstones of the Nations, Oxford University press,1999.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: understand the factual and theoretical knowledge of the nature and working of Indian Constitution
CO2: working of the three organs of state
CO3: legislative procedure, Judicial review and Independence of Indian judiciary.

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

Mapping of Programme Educational Objectives with Course Outcomes
A broad relation between the Programme Objective and the outcomes is given in the following table:

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

Mapping of Program Specific Objectives with Course Outcomes
A broad relation between the Program Specific Objectives and the outcomes is given in the following table:

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

GENERAL ENGLISH-II

OBJECTIVE:
The course aims at familiarizing the students with effective use of words and sentences, effective writing of paragraphs, Business correspondence and oral presentations skills.

Credits: 05 **Trimester II** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
Module I	**Phrasal Verbs:** Separable & Inseparable, Learn the several verb combinations with distinct meanings, Practice using Phrasal Verbs effectively. **Effective Use of Words & Sentences**: Understand the principles to be applied in selecting words, identify redundancy and learn to avoid cliché and vague words, Express the ideas clearly by using words effectively, Sentence structure and types, Subordination & Coordination, Active & Passive, Parallel Constructions, Principles of constructing effective sentences. **Effective Paragraphs:** Principles of Effective Paragraphs, Learn how to build Effective Paragraphs through Unity, Coherence and Emphasis, Acquire the skill of writing effectively. **Business Correspondence:** Business Letters: Structure, Components and Formats, Types of Business Letters and their essential features, Develop the skill of drafting Enquiry letters, Quotation letters, Order letters, Acknowledgement letters, Cover letters, etc., Learn effective beginnings and closings of these letters, Gain proficiency in writing business letters concisely, naturally, clearly and positively.	**24**
Module II	History of Legal English **Spotting Errors:** Punctuation Vocabulary: spellings and Derivation of Latinate Words Syntax: Analysis of Simple, Complex and Compound Sentence Reading: Act-IV, Scene I, Merchant of Venice: A Court of Justice by William Shakespeare, Discourse analysis by students. Recommended Movie: Merchant of Venice (2004) directed by Michael Radford **Presentation Strategies:** Individual/Group Presentations Learn how to prepare the Presentations, Know how to master the	**24**

	various techniques of effective speech delivery along with the practice, Learn how to manage question & answer session.	

Focus: This course focuses on skill development aligned with all Cos

LEARNING OUTCOMES:

Students will have skills to write proper formal professional English.

Students will learn how to use the right words and phrases for effective writing.

SUGGESTED READINGS:

- Aruna K. Dr., Professional Communication, Tata McGraw, Hill Education Private Limited, 2008.
- Hornby A.S., Oxford Advanced Learner's Dictionary, Oxford University Press.
- Daniel Jones, Cambridge English Pronouncing Dictionary, Cambridge University Press.
- Quirk R., Greenbaum S., Leech G. and Svartik J., A Comprehensive Grammar of the English Language, Longman, London.

LAW OF CONTRACT – I

OBJECTIVE:

This course will discuss the primary purpose of contract law, is to enforce the agreement of the parties. For there to be a contract, substantial agreement must exist and the parties must have freely intended to be legally bound. A breach occurs when one party foils the intentions of the other party. It will be helpful to the students to acquire the knowledge and how Contract as formed and its essentiality.

Credits: 06 **Trimester IV** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	**Formation of Contract-** Agreement and Contract- Definitions –Offer/Proposal and Acceptance: Definition, Communication, General/Specific offer, Cross offer, Counter offer, Invitation of treat- Tenders, Standard form of Contract. **Consideration-** Nudum Pactum- Essential elements- NO Consideration No Contract **Privities of Contract-** Unlawful Consideration and its effect. **Capacity to Contract-** Minor's Agreements and its effects- Persons of Unsound mind- Persons disqualified by Law.	30
II	Free Consent- Coercion –Undue Influence- Misrepresentation – Fraud – Mistake- Legality of Object- Void Agreement – Agreement- against Public Policy- wagering Agreements- Its exceptions- Contingent Contracts. Effect of Void- Voidable, Valid illegal, unlawful and uncertain agreement/ contracts. Discharge of Contracts and its various Modes- by performance – By operation of Law. Doctrine of frustration (Impossibility of Performance) **Breach-** Anticipatory breach and Actual breach. **Quasi Contract** (Section 68-72). **Remedies for Breach of Contracts** – Damages – Types of damages- Remoteness of damage, Quantum Merit.	30

TEXT BOOKS:

- Singh Avtar, Law of Contract, Eastern Book Co, 12th edition, New Delhi, (2017).
- R.K. Bangia, Law of Contract-II, Allahabad Law Agency, Prayagraj, (2019).
- S.S. Srivastava, Law of Contract-I & II, Central Law Publication, 5Th edition, New Delhi, (2015).
- Bare Act, The Indian Contract Act, 1872, Universal Law Publication, New Delhi, (2016).

REFERENCE BOOKS:

- Pollock & Mulla, Indian Contract Act", Lexis Nexis, (2013).
- Anson's, Law of Contract", Offord University Press, (2015).
- Stephen A. Smith/Atiya, Law of Contract, Oxford, University Press, (2016).
- Jill Poole, Contract Law, Sixth Edition, Oxford university press, (2003).

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Acquired the basic knowledge of contracts.
- CO2: Know the validity of contracts which would help them to defend their clients.
- CO3: Acquainted with modes of discharge of contract which help them to apply in practical cases.
- CO4: Gain the knowledge about the forum and the cases under which remedy for breach of contract will be available.

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

COs	**POs/PSOs**
CO1	PO4/PSO2
CO2	PO4/PSO1/PSO2
CO3	PO2/PSO2
CO4	PO3/PSO1/PSO2

BALC 1003: FAMILY LAWS - I

OBJECTIVE:

This course focuses on various aspects of family law including marriage, adoption and related rights and liabilities. Both Hindu Law and Muslim Law along with emerging issues are covered under the paper. The objective is not only to make students well verse with codified law but also to make them understand sensitive issues relating to marriage and child custody.

Credits: 06 **Trimester IV** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Introduction and origin of Marriage** - Sources of Hindu law: Ancient and Modern Sources, Schools of Hindu Law: Mitakshara and the Dayabhaga School. **Law of Marriage** - Hindu Marriage Act, 1955, Hindu marriage: Essential of a valid marriage, Void and Voidable Marriage, Matrimonial Remedies and Obligations: (Hindu Law) -Restitution of Conjugal Rights, Judicial Separation, Dissolution of Marriage under Hindu Law, **Dissolution of Marriage:** Theories, Forms of Divorce, Grounds, Divorce by Mutual Consent, Irretrievable Breakdown as a Ground for Dissolution. Adoption, **Maintenance and Guardianship:** Hindu Adoption and Maintenance Act, 1956 & Hindu Marriage Act, 1955, Adoption, Ceremonies, Capability, Effect, Inter country adoption, Maintenance, Entitlement, Enforcement. Hindu Minority and Guardianship Act, 1956, Meaning, Kinds of guardianship, Right, Obligations and disqualification of guardian	30
II	**Introduction-** Who is Muslim? Sources of Muslim Law, Ancient and Modern Sources Schools of Muslim Law. **Muslim marriage -** Nikah (Muslim Marriage) Definition, objects and nature, Essentials and validity. **Dower -** Definition, concept, kinds and nature of dower under Muslim Law. **Dissolution of Marriage under Muslim Law -** (Divorce) Talaq: Concept, Ila, Khula, Mubarrat, Talaq-e-Tafweed, Lian, Faskh and recent developments in Triple Tala and Modes of dissolution of Muslim-marriage. **Adoption, Maintenance and Guardianship Parentage and Legitimacy -** Maintenance under Muslim Women (Protection of Rights on Divorce) Act, 1986 and under the Code of Criminal Procedure, 1973**.**Classification of Guardians, Natural Guardians, Guardians appointed by Court and power and functions of Guardians under Muslim Law. Parentage and Legitimacy under Muslim law.	30

TEXT BOOKS:

- Diwan, Paras (2018), Family Law, Allahabad Law Agency, Allahabad.
- Gandhi, B. M. (2016), Family Law, Eastern Book Company, New Delhi.
- Diwan, Paras (2017), Muslim Law in Modern India, Allahabad Law Agency, Allahabad.

REFERENCE BOOKS:

- Kusum, (2015), Family Law Lectures – Family Law I, Allahabad Law Agency, Allahabad.
- Fyzee, A. A. A. (1974), Outlines of Mohammadan Law, Oxford University Press, New Delhi.
- Mulla, (1906), Principles of Mohammadan Law, Lexis Nexis Publication, London.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Create awareness of the family law in the society thereby the needed people may get justice by resolving their issue by filling petition in the court of law.
- CO2: Present logical legal arguments by exhibiting the ability to research and critically analyze and apply legal knowledge in legal problem solving and conflicting perspectives.
- CO3: Communicate effectively in oral and in writing, using language and legal terminology accurately and effectively in the legal profession.
- CO4: Apply legal knowledge to complex problem situations and offer potential solutions within a simulated professional context.

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

COs	**POs/PSOs**
CO1	PO4/PSO2
CO2	PO4/PSO2
CO3	PO2/PSO2
CO4	PO3/PSO1/PSO2

HISTORY-III (MODERN EUROPE AND THE WORLD)

OBJECTIVE:

The objectives of studying this course are the followings:

- To analyze the Latin and Roman legal system
- To understand the French Revolution
- To evaluate the Parliamentary system in UK
- To generate the analytical skills in order to understand the changing dynamics of world history.
- To familiarize students of law with the history of Europe as many international laws/ human rights/ humanitarian laws emanate from developments in Europe.

Credits: 05 **Trimester V** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
I	Latin and Roman Judicial system **The French Revolution**: Liberty, Equality, Fraternity Magna Carta System Evolution of Parliamentary System in UK	24
II	American Revolution International Relations and event leading to armament race Nationalism and the armament race, The Hague Conventions, First World War: League of Nations, Interwar years and the Second World War, Humanitarian Concerns and United Nations	24

TEXT BOOKS:

- Parker, Philip (2017), World History: From the Ancient world to the Information Age, Dorling Kindersley Limited
- Hazen, Charles Downer (1963), Modern Europe up to 1945, Palala Press Publisher, New Delhi.
- Doyle, Willaim (2018), The Oxford History of the French Revolution, Oxford University Press.
- Roy, Tirthankar, (2011), Economic History of India 1857- 1947, Oxford University Press, New Delhi.
- Joshi, Vandna, Revisiting Modern Europe History, 1789-1945, Pearson India, First Paper Book, Edition, 2016.

REFERENCE BOOKS:

- Dutt, R. C. (2017), The Economic History of India Volume I &II, Publisher Ministry of Information and Broadcasting, Govt. of India, New Delhi.
- Sinha, Arvind (2010), Europe in Transition from Feudalism to Industrialization, Manohar Publications, New Delhi.
- Merriman J. (2019), History of Modern Europe Volume I & II, W. W. Norton Publishers, New York.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Conceptualize the history of Europe as many international laws/ human rights/ humanitarian laws emanate from developments in Europe.
- CO2: Understand the First World War: League of Nations, Interwar years and the Second World War.
- CO3: Critically analyze the international trade law.
- CO4: Learn about the French Revolution.

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

COs	**POs/PSOs**
CO1	PO4/PSO4
CO2	PO4/PSO4
CO3	PO2/PSO4
CO4	PO3/PSO1

LAW OF CONTRACT – II

OBJECTIVE:

This course will discuss:

- The general principles of contract emphasis on understanding the basic essentials of a valid contract. In the present scenario, a law student should also acquaint himself with the knowledge of special contracts apart from equipping himself with general principles of contract.
- This course familiarizes students to better appreciate the legal services required in a corporate office so that he can enhance his relevance as a lawyer in the society.
- This course focuses on the special contracts and provides an insight of statutory provisions.

Credits: 06 **Trimester II** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	Contract of Indemnity and Guarantee (Sec. 124-147), Indemnity & Guarantee- the Concept, Definition, Nature and scope, Rights of Indemnity holder- Commencement of the Indemnifier's liability, Distinction between Indemnity and Guarantee, Rights/Duties of Indemnifier, Indemnified and Surety, Extent of Surety's liability- Co-surety, Discharge of Surety's liability, Kinds of Guarantee, Bailment and Pledge (Sec. 148-171 and Sec. 172-181), Contract of Bailment- Definition – kinds – Rights and Duties of Bailer and Bailee, Rights of Lien.	30
II	Contract of Pledge- Definition- comparison with Bailment, Rights and Duties of Pawnor and Pawnee, Termination of Bailment, Agency (Sec. 182 – 238), Definition of Agent and Principal, Essentials of relationship of Agency, Rights and Duties of Agent, Creation of Agency: by agreement, ratification and law, Relation of Principal/ agent, sub agent, substituted agent, Personal liability of agents, Termination of agency. **Specific Relief Act, 1963**: Nature of Specific Relief, Meaning of Specific Performance, Enforcement of Contract, Specific performance when granted and not granted, Preventive Relief- Temporary Injunctions- Perpetual and Mandatory Injunction.	30

TEXT BOOKS:

- Sings Avatar, Law of Contract, 12th edition Eastern Book Co, 2017
- R.K. Bangia, "Law of Contract-II", Allahabad Law Agency, 2019
- S.S. Srivastava, "Law of Contract-I & II", 5Th edition, Central Law Publication, 2015
- The Indian Contract Act, 1872. Bare Act by Universal Law Publication 2016

REFERENCE BOOKS:

- Pollock & Mulla, "The Indian Contract Act", Lexis Nexis, (2025).
- Anson's," Law of Contract" Oxford university press (2016).
- Stephen A. smith/Atiya, "Law of Contract", Oxford University Press (2006).
- Jill Poole." Contract Law", Oxford university press. (2003).

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Gain knowledge relating to contract of Indemnity which would help them to deal with cases of banks and consumers.

- CO2: Good knowledge relating to bailment and pledge which would help them to deal with cases of banks, companies, and consumers.
- CO3: Acquainted with law relating to agency, the rights and duties of agent and principal which would help them to deal cases of banks.
- CO4: Emphasize on the study of remedies provided in the law

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

COs	**POs/PSOs**
CO1	PO3/PO4/PSO4
CO2	PO4/PSO4
CO3	PO2/PSO4/PSO7
CO4	PO3/PSO1

FAMILY LAWS – II

OBJECTIVE:

The Main objective of this course is to deal with the succession under the Hindu, Muslim Laws. Matters relating to joint family system, role of Karta, laws relating to partition and religious endowments have been included in the course. Under Muslim Law, wills, Gifts and pre-emption have been included in separate modules along with Sunni and Shia Law of Inheritance. Modes and laws of Inheritance under Muslim law have been included for better understanding.

Credits: 06 **Trimester V** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Joint Hindu Family and Coparcenary:** Meaning, Characteristics & Distinction between Hindu Joint Family and Coparcenary, Distinction between Mitakshara & Dayabhaga Coparcenary, Rights of Coparceners and Position of Female Coparceners, Karta – Position, Powers and Rights & Duties. **Joint Family Property:** Ancestral, Doctrine of Accretion, Doctrine of Detriment, Doctrine of Blending. Separate or Self Acquired Property, Inherited Property under Hindu Succession Act, 1956 Alienation of Hindu Joint Family Property – Karta's & Coparcener's Power of Alienation. **Partition:** Meaning, Subject Matter, Modes, Revocation **Law of Succession:** General principles of succession under Hindu. **Wills:** Wills, Codicil sand Kinds of will Indian Succession Act, 1925.	30
II	**Law of Succession:** General principles of succession under Muslim, difference between Intestate Succession and Testamentary Succession, General Rules of Inheritance - Classification of Heirs under the Shia Law & Sunni Law **Gift (Hiba) and Wills (Wasiyat) under Muslim Law:** Meaning, Objects & Essentials of a Valid Gift and Revocation, Irregular Gifts under Shia, and Sunni Law. Definition, essentials and subject matter of Wills (Wasiyat). testamentary right: One Third Rule. Abatement of Legacies. Revocation of Wills. Reteable distribution under Sunni law and Preferential distribution under Shia Law. Death-bed Gifts. **Right of Pre-Emption (Shufa):** Definition, Essentials Elements and Nature of Pre-Emption. Existence of the Right and formalities: three Demands and legal effects of Pre-Emption.	30

TEXT BOOKS:

Diwan, Paras (2018), *Family Law*, Allahabad Law Agency, Allahabad.

- Gandhi, B. M. (2016), *Family Law*, Eastern Book Company, New Delhi.
- Diwan, Paras (2017), *Muslim Law in Modern India*, Allahabad Law Agency, Allahabad.

REFERENCE BOOKS:

- Kusum, (2015), *Family Law Lectures – Family Law I*, Allahabad Law Agency, Allahabad.
- Fyzee, A. A. A. (1974), *Outlines of Mohammadan Law*, Oxford University Press, New Delhi.
- Mulla, (1906), *Principles of Mohammadan Law*, Lexis Nexis Publication, London.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Comprehend and explain key legal concepts underpinning India's Succession Law system
- CO2: Critically evaluate the challenges and debates surrounding Succession Law
- CO3: Identify, analyze and critically assess disputes between parties involving issues of ancestral, self-acquired and separate property and succession and, Wills under Hindu and Muslim law
- CO4: Demonstrate legal problem-solving skills, which generate appropriate responses to complex statutory problems in the field of Family Law.

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

COs	**POs/PSOs**
CO1	PO1/PO2/PSO7
CO2	PO2/PO3/PSO6
CO3	PO1/PO2/PSO6
CO4	PO3/PSO2

INTERPRETATION OF STATUTES

OBJECTIVE

In terms of law it is not only necessary to enact the law but the proper implementation of the same as well. This can be insured only by ensuring the mechanism in which least ambiguities, inconsistencies, contradictions, or lacunas are found. This mechanism can be developed only through finding out the proper tools of interpretation of enacted, codified laws and customs. Study of law of interpretation is only ensuring that mechanism and parts of it.

Credits: 06 **TRIMESTER II** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	Interpretation -Meaning, Definition, Object, Nature and Scope. General Rules of Interpretation. Meaning of the term Statutes- Title, Preamble, Heading and Marginal Notes, Punctuation marks, Illustration, Exceptions, Proviso and Saving clause, schedule, Non-obstante clause. Statute- Commencement and Repeal thereof, Procedure of Passing a Bill. The General Clause Act, 1897: Nature, Scope and relevance, definitions in various legislations.Parts of a Statute - Commencement, operation and repeal and revival of statutes, Purpose of Statutory Interpretation. Various rules of construction -Literal Rule of Interpretation, Golden Rule of Interpretation, Mischief Rule of Interpretation, Beneficial construction, Restrictive Construction Rule of Strict Rule of Interpretation, Harmonious Construction, and Interpretation of Taxing Statutes.	30
II	Interpretation of Constitution - Doctrine of Pith and Substance and Colorable Legislation. Preamble as a tool – Reading Directive Principles and Fundamental Duties with Fundamental Rights. Intrinsic and Extrinsic Aids to Interpretation - Dictionaries, pronunciation and legal abbreviations, Methods of studying law: and lectures, evaluation, Case law method: Explanation, Case Studies and evaluation, Using the library: Law reports, methods of using a law dictionary and of finding a reference: Examples and exercises. Maxim - Ejusdem Generis, Expressio Unius Exclusio Alterius and Pari Materia.	30

TEXT BOOKS:

- Vepa Sarathi - Interpretation of Statutes, Eastern Book Co. (EBC); 2015 edition (2015)
- G.P. Singh - Principles of Statutory Interpretation (Also Including General Clauses Act, 1897 With Notes), Lexis Nexis; First edition (25 May 2016)

REFERENCE BOOKS:

- Jeremy Bentham - Theories of Legislation, Lexis Nexis; Second edition (2010)
- Jeremy Bentham – An Introduction to the Principles of Morals and Legislation, Dover Publications Inc. (5 June 2007)
- William Fielden Craies and S.G.G. Edgar, Craies on Statute Law, Sweet & Maxwell; 7th Revised edition (1 December 1971)
- Maxwell - Interpretation of Statutes, Lexis Nexis; First edition (2010)

Focus: This course focuses on skill development aligned with all Cos

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Find out the true sense of an enactment by giving the words of the enactment their natural and ordinary meaning.
- CO2: Understand the process of statute making and the process of interpretation of statutes.
- CO3: Apply rules of interpretation while interpreting the statute.
- CO4: Understand the principles for interpretation of Constitutional document.

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

COs	**POs/PSOs**
CO1	PO3/PO4/PSO4
CO2	PO1/PSO2
CO3	PO2/PSO7
CO4	PO3/PSO6

LABOUR LAW- I

OBJECTIVE:

The objectives of studying this course are-

- To study relevant Constitutional provisions to ensure labour protection, protection of basic rights of labour, effective implementation of labour laws
- To categorize the different classes of labour in India.
- To understand the different dimensions of socio-economic problems faced by the labors in India and other countries.
- To understand the judicial role in upholding and ignoring the Labour Jurisprudence in changing socio-economic conditions
- To make the students aware of the new forms of exploitation of the labours in the era of Globalization Privatization and Liberalization.

Credits: 06 **Trimester VIIL–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	Brief history of Trade Union movement in Britain in India and the enactment of the Indian Trade Union Act. Provisions contained in the Trade Union Act. The interplay of provisions in this Act and the other Acts. The Trade Union Act and the related Constitutional provisions in the light of ILO Conventions and Recommendations. Trade Union immunities and their relevance in the present-day context. Recognition of Trade Unions - need and the efforts made in this direction - Methods for identifying the strength of Trade Unions. Minors as employees and their rights relating to Trade Union. Collective bargaining. The legislative framework for collective bargaining, weapons of collective bargaining - Status of collective bargaining settlements - collective bargaining in the context of liberalization.	30
II	**Industrial Dispute Act:** Development of Industrial Disputes Legislation in India, Object and applicability of the Act **,** Definition of Industry, Industrial Dispute, Workmen and 'Public Utility Service', Authorities under Industrial Dispute Act, 1947, Duties and jurisdiction of adjudicating authorities**,** Procedure and power of authorities, Voluntary reference of disputes to Arbitration, Lay-off, Retrenchment, and Closure, Strike and lockout, Unfair Labour Practices, Disciplinary Action and Domestic Enquiry, Management's Prerogative during the Pendency of Proceedings, Notice of Change. **The Industrial Employment (Standing Orders) Act, 1946:** Concept and Nature of Standing Orders, Scope and Coverage of the Industrial Employment (Standing Orders) Act, 1946, Certification Process, Modification and Temporary Application of Model Standing Orders, Interpretation and Enforcement of Standing Orders, Penalties and Procedure.	30

LEARNING OUTCOME:

1. The student will be able to understand the importance and relevance of Industrial Jurisprudence emphasizing on Social Justice.

2. The student will understand the evolution of labour legislation in India with specific reference to state.

3. The student will be able critically analyze the important labour and industrial legislations and their relevance in Indian context.

4. The student will be familiar with the latest development in the field of labour and industrial laws.
5. The student will be able to apply the relevant laws to actual cases/situations.

Focus: apply the relevant laws to actual cases/situations

TEXT BOOKS:

- Kaufman B. K. (2006). *The Global Evolution of Industrial Relations: Events, Ideas AND The IIRA*. Academic Foundation.
- Rao E. M. (2015). *Industrial Jurisprudence –A Critical Commentary*. New- Delhi: Lexis Nexis
- Pillai K. M. (2015). *Labour and Industrial Law*. Allahabad: Allahabad Law Agency.
- Malhotra O. P. (2015). *The Law of Industrial Disputes.* New Delhi: Lexis Nexis.
- Srivastava S. C. (2007). Industrial Relations and Labour Laws. New Delhi: Vikas Publishing House.
- Mishra S. N. (2016). *Labour and Industrial Laws*. Allahabad: Central Law Publications

REFERENCE BOOKS:

- M.S Siddiqui, Cases and Materials on Labour Law and Labour Relation, Indian Law
- Institute, 1963
- P.L. Malik, Industrial Law, Eastern Book Company, 2013
- Dr. Goswami, Labour and Industrial Law, Central Law Agency, 2011
- Chaturvedi, Labour and Industrial Law, 2004
- ZMS Siddiqi and M.Afzal Wani, Labour Adjudication in India, ILI, 2001.

LAW OF CRIMES – I

OBJECTIVE:

The purpose of the Paper is to enable the students to understand the general principles of criminal liability, to identify the ingredients of an offence, understand the range of state of mind required for different offences. The primary objectives of this course are: - To acquaint the students with the key concepts of crime and criminal law, To expose the students to the range of mental states that constitute mens rea essential for committing a crime, To teach specific offences under the Indian Penal Code, To keep students abreast of the latest developments and changes in the field of criminal.

Credits: 6 **Trimester VII** **L–T–P: 4– 2–2**

Module No.	Content	Teaching Hours
I	**Extent and operation of the Indian PenalCode:** Definition ofCrime, **Constituents Elements of Crime**: *Actus Reus* and *Mensrea* . **General Exceptions:**(Sections76-106)-Mistake, Judicial and Executive act, Accident, Necessity, Infancy, Insanity, Intoxication, Consent, Good Faith Private defense against Body and Property. Joint and Constructive Liability Criminal (Sections 49 &149)	30
II	**Inchoate crimes:** Conspiracy, Attempt, Abetment. (sections 107,120A,120B &511) Offences against theState.(sections 121,124A) Offence against PublicTranquility.(sections 141,146&159.) Theories of Punishment with special reference to CapitalPunishment. .	30

LEARNING OUTCOME:

The students will be able to understand the general principles of criminal law, key concepts, its application and recent developments in the field.

Focus: criminal and its application

TEXT BOOKS:

- K.T. Thomas, M.A. Rashid (Rev.), **Ratan Lal & Dhiraj Lal's *The Indian Penal Code***, (34th ed., 2014)
- K.D. Gaur, Criminal Law: ***Cases and Materials***, (8th ed., 2015)
- R.C. Nigam, ***Law of Crimes in India*** (Vol. I) (1965)
- V.B. Raju, ***Commentary on Indian Penal Code***, 1860 (Vol. I & II) (4th ed., 1982)
- K.N.C. Pillai &ShabistanAquil (Rev.), ***Essays on the Indian Penal Code*** (The Indian Law Institute, 2005) 6) K. I. Vibhute (Rev.), P.S.A. Pillai's ***Criminal Law*** (12th ed., 2014)
- Syed Shamsul Huda, ***The Principles of the Law of Crimes in British India*** (1902)

K.N. Chandrasekharan Pillai, ***General Principles of Criminal Law***(2nd ed., 2011

POLITICAL SCIENCE- PUBLIC ADIMISTRATION

OBJECTIVE:

The objectives of studying this course are the followings

- To apply the concepts of Public Administration in real cases
- To analyze he changing nature of state-society-economy relationships in a globalized world.
- To understand the new approaches in Public Administration
- To evaluate the classical and modern theories of Public administration
- To define the basic principle of public policy as well as entrepreneurial concept
- To generate the analytical skills in order to understand the changing dynamics of Public Administration

Credits: 05 **Trimester VII** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
Module - I	Public Administration as a Discipline: Meaning, Dimensions and Significance of the Discipline. Public Administration in the age of Globalization: New Public Administration, New Public Management,Challenges of liberalization, Privatization, Globalization; Good Governance: concept and application Weber's bureaucratic model - its critique and post-Weberian Developments; Dynamic Administration (Mary Parker Follett); Human Relations School; Simon's decision-making theory; Participative Management (R. Likert, C. Argyris, D. McGregor), Kautilya's Arthashastra; Legacy of British rule in Indian administration. Emerging Trends in Public Administration: E-Governance, Public-Private Partnership	**24**
Module - 2	Public Policy: Definition, characteristics and models, Public Policy Process in India Decentralization: Meaning, significance and approaches and types, Local Self Governance: Rural and Urban Budget: Concept and Significance of Budget, Various Approaches and Types Of Budgeting Citizen and Administration Interface: Public Service Delivery, Redressal of Public Grievances: RTI, Lokpal, Citizens' Charter and E-Governance	**24**

LEARNING OUTCOMES

- The student will be able to conceptualize the changing nature of Public Administration.
- The student will be able to understand the market-state relations since the 1990s.
- The student will be able to critically analyze the new approaches in Public Administration.
- The student will understand the basic principle of public policy as well as entrepreneurial concept.
- The student will be able to evaluate the classical and modern theories of Public administration.

Focus: critically analyze the new approaches in Public Administration.

REFERENCE BOOKS:

Module - I

1. Yescombe, E. R. and Edward Farquharson (2018), *Public Private Partnership for Infrastructure: Principles of policy and finance,* Butterworth-Heinemann
2. Fredrikson, (2004) 'Toward New Public Administration', in Shafritz, J.M. and Hyde, A.C. (eds.) Classics of Public Administration. 5th Edition. Belmont: Wadsworth, pp.315- 327.
3. Bhattacharya, M. (2008) New Horizons of Public Administration. 5th Revised Edition. New Delhi: Jawahar Publishers, pp. 21-30
4. D. Ravindra Prasad, V.S. Prasad and P. Satyanarayana (2010). Administrative Thinkers, D. Gvishiani Organisation and Management: A Critique of Western Theories

Module - II

1. Chakrabarti, Rajesh and Kaushiki Sanyal (2017), *Public Policy in India,* Oxford University Press
2. Trotta, Anthony (2017), *Advances in E-Governance: Theory and Application of Technological Initiatives,* Routledge

3. Mullen, Rani (2017), *Decentralization, Local Governance, And Social Wellbeing In India: Do Local Governments Matter?* Routledge

4. Gabriel Almond and Sidney Verba, The Civic Culture, Boston: Little Brown, 1965 M.P.Lester, Political Participation- How and Why do People Get Involved in Politics Chicago: McNally, 1965
5. Erik-Lane, J. (2005) Public Administration and Public Management: The Principal Agent Perspective. New York: Routledge
6. R. Putnam , Making Democracy Work , Princeton University Press, 1993 Jenkins, R. and Goetz, A.M. (1999) 'Accounts and Accountability: Theoretical Implications of the Right to Information Movement in India', in Third World Quarterly

PROPERTY LAW AND EASEMENT LAW

OBJECTIVES:

The objectives of studying this course are-

- To equipping students with the concept of property
- To explain various provisions of the Transfer of Property Act, 1882 and Easement Act, 1882
- To demonstrate the operation for transfer of immovable property.
- To outline the substantive law relating to particular transfers, such as sale, mortgage, lease, exchange, gift and actionable claims.
- To build the strong command on underlying of easements and licences, the rights of parties, etc.

Credits: 6 **Trimester VII** **L–T–P: 4– 2–2**

Module No.	Content	Teaching Hours
Module-I	**Concept of Property and General Principles Relating to Transfer of Property:** Concept of property: distinction between moveable and immoveable property**,** Definition clause: Immovable property, Attestation, Notice, Actionable claim**,** Definition to transfer of property (Sec.5)**,** Transfer and non-transfer property (Sec.10-12)**,** Transfer to an unborn child and rule against perpetuity (Sec.13, 14, 17)**,** Vested and Contingent interest (Sec.19 & 21)**,** Rule of Election (Sec.35)	30
Module-II	**General Principles Governing Transfer of Immoveable Property:** Transfer by ostensible owner**,** Rule of feeding the grant by estoppels**,** Rule of Lis pendens**,** Fraudulent transfer**,** Rule of part performance e**,** Vested and contingent interest**,** Conditional transfer **Specific Transfers and Easement Act:** Sale and gift**,** Mortgage and charge**,** Lease and License**,** Object and main provisions of the Easement Act**,** Creation of Easement**,** Riparian rights, introduction of Equity and Trust Law.	30

LEARNING OUTCOMES:

- Students would be able to understand clear, systematic and uniform law for transfer of immovable property.
- Students would be able to understand various provisions *inter- vivos.*
- Students would be able to apply principles of justice, equity and good consciences, if a particular case is not governed by any provision of law.
- Students would be able to know various modes of transfer of property and easements rights.

Focus: To know various modes of transfer of property and easements

REFERENCE BOOKS:

- Mulla, Transfer of Property Act, 1999, Universal Delhi
- Subba Rao, Transfer of Property Act, 1994, Subbiah Chetty, Madras
- V.P.Sarathy, Transfer of Property, 1995 Eastern Book Co.

- T.P.Tripathi, Transfer of Property Act, 2007
- S.N.Shukla, Transfer of Property Act, 2007

STATUTORY MATERIALS:

- The Transfer of Property Act, 1882
- The Indian Easement Act, 1882

ADMINISTRATIVE LAW

OBJECTIVE:

The paper will make the students aware of various aspects of Administrative Law including quasi legislative ,quasi-judicial and other ministerial functions of administration and control thereof with a practical approach.

Credits: 06 **Trimester VIIIL–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Evolution and Scope ofAdministrative Law: -** Nature, Scope and Development of Administrative Law ,Rule of Law and AdministrativeLaw ,Separation of Powers and itsRelevanceRelationship between Constitutional Law and AdministrativeLaw ,Classification of AdministrativeLaw **Meaning and Concept of DelegatedLegislation: -**Constitutionality of DelegatedLegislation**, Control**Mechanism**:** Parliamentary Control of Delegated Legislation**,** Judicial Control of Delegated Legislation**,** Procedural control of DelegatedLegislation, Sub-Delegation **Judicial Function of Administration: -** Need for adjudicatory authority on administration, Problem of Administrative Decision Making, Nature of Administrative Tribunals: Constitution, Powers, Procedures, Rules of Evidence Principles of Natural Justice: - 1 Rules against bias 2-Audi Alteram Partem 3- Speaking Order	30
II	**Administrative Discretion and Judicial Control of Administrative Action**: -Need and its Relationship with Rule ofLaw, Judicial Review of Administrative Action and Grounds of Judicial Review: Abuse ofDiscretion, Failure to ExerciseDiscretion, Illegality, Irrationality, ProcedureImpropriety Doctrine of LegitimateExpectations, Evolution of Concept of*Ombudsmen*, *Lokpal*and *Lokayukta*Act and other Anti-corruption Bodies and their AdministrativeProcedures	30

LEARNING OUTCOME:

The students will be able to adopt a pragmatic approach in studying Public law, will be familiarize with the relationship between law and society, to understand basic ideas and fundamental principles Natural Justice. The application of Constitutional law and its application Students will be able to face exigencies of life.

Focus: emphasis on pragmatic approach in studying Public law

TEXT BOOKS:

- H.W.R. Wade & C.F. Forsyth, *Administrative Law*, Oxford University Press, 2009 (12thEdn)
- M.P. Jain & S.N. Jain, *Principles of Administrative Law*, Lexis Nexis, 2013 (7thEdn)
- Stanley De Smith & Rodney Brazier, *Constitutional and Administrative Law*, Penguin, 2000

REFERENCES:

- I.P. Massey, *Administrative Law*, Eastern Book Company, 2012,(8th
- C.K. Takwani, *Lectures on Administrative Law*, Eastern Book Company, 2012 (5thEdn)
- S.P. Sathe, *Administrative Law*, Lexis Nexis Butterworths Wadhwa, 2010 (7thEdn)

LABOUR LAW- II

OBJECTIVE:

The objectives of studying this course are to study the paper which will focus on wages, wage policies, compensation, social security and retirement benefits during the course of employment and working conditions of employees.

Credits: 06 **Trimester VIIIL–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Wages including minimum wages:** Definition of wages as given in the Industrial Disputes Act; Components of wages -Basic wages, Dearness Allowance and other allowances, indirect remuneration. Consumer price index, neutralization of price raise, etc. Different types of wages like minimum wages, fair wage and living wage. How these categories of wages will be determined. Minimum Wages Act will be dealt elaborately keeping in mind the judicial developments in this area and the ground realities. This module will also address issues like financial capacity of the employer; Industry-cum-region formula while fixing wages; equal pay for equal work - Equal Remuneration Act, 1976; Constitutional dimension of equal pay for equal work; Authorised deductions and procedure for the same as envisaged under the Payment of Wages Act. Implications of Wage Code,2019. **Bonus:** Brief history as to the payment of bonus; The contribution of Labour Appellate Tribunal and the judiciary in this regard; Payment of Bonus Act 1965 will be dealt in detail. Minimum Bonus and Maximum Bonus; Concepts of Available surplus and Allocable surplus; Whether bonus is deferred wages when the Statue prescribes minimum bonus to be paid irrespective of losses incurred by the employer. Customary Bonus; Exemptions for Start Up's **Employment injury compensation and liability of the employer to pay compensation:** Prevention of employment injury - relevant provisions of Factories Act ; Tort Law Liability in case of employment injury ; Fatal Accidents Act ; Employees' Compensation Act ; Employees State Insurance Act ; Classification of injuries; Disablement, Permanent total disablement; Permanent partial Disablement, Temporary disablement, Temporary total disablement, Temporary partial disablement, Occupational Diseases; Injury arising out of and in the course of employment, Physical injury and Psychological injury; Notional extension of time and place of the premises of employment; Doctrine of Added Peril; Non liability of Employers under the statutory framework; Computation of compensation under the Employees Compensation Act; Indemnification; How there is scope for improving upon these Statutory minimum standards. Rate of contribution under ESI Act; Benefits under ESI Act and the improvements made from Employees Compensation Act; Computation of benefits under ESI Act; Bar against receiving or recovery of compensation or damages under any other law;Need for taking insurance where ESI Act is not applicable. Medical insurance for employees.	30

II	**Retirement benefits:** This area of social security will address the legislations like Employees Provident fund – Contributory Provident Fund, 1925 Act as well as 1952 Act;Schemes envisaged under the Act, Concept of International Worker; Social Security Agreements; Provision for pension integrated to the contributory provident fund. Payment of Gratuity Act, 1972,Eligibility parameters; Formula for computing Gratuity; Employee Share option schemes and how they are working **Women and Welfare**: Social Security and Labour Welfare Provisions relating to women workers. Maternity Benefit Act, Shops and Commercial Establishments Act, 1962 etc.; The amendments brought out to Maternity benefits in 2017;The improvements made thereon from the Maternity Benefit Act; Special Provisions under the ESI Act; Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013;The History behind the legislation; Vishaka Guidelines; The constitution of Committees; The procedure for filing the complaint; The punishments meted out ; Appeal provisions; Scope for departmental proceedings and criminal proceeding to go on simultaneously. **Miscellaneous Legislations:** Factories Act, 1948; Definition of Occupier and Manufacturing process; Health,safety and welfare aspects of factory workers; The amendments brought in in the wake of Bhopal Gas Leak disaster in the Factories Act. Shops and Commercial Establishments Act, 1962;The definition of commercial establishment; Work hours; Progressive State Amendments regarding the same; Unorganized Workers Social Security Act, 2008; Definition of unorganized worker-How inclusive it is; The salient features; Schemes envisaged for unorganized workers; Building and Other Construction Workers (Regulation of Employment and Conditions Of Service) Act, 1996 and the related Welfare Cess Act.	30

LEARNING OUTCOME:

1. The student will be able to understand the provisions of renumeration and right of minimum wages.

2. The student will understand the importance of social legislations which are benefitting the employees in the form of funds or insurance.

3. The student will be able to critically analyze the minimum facility requirements for a factory.

4. The student will be able to understand his social obligation to protect the weaker sections of the society.

Focus: it will understand the importance of social legislations

TEXT BOOKS: (Latest Editions)

- Pillai K. M. (2015). *Labour and Industrial Law*. Allahabad: Allahabad Law Agency.
- Mishra S. N. (2016). *Labour and Industrial Laws*. Allahabad: Central Law Publications
- Goswami V. G. *Labour and Industrial Laws*.Allahabad: Central Law Agency.
- Khan & Khan*Labour Law*. Hyderabad: Asia Law house.
- Srivastava K. D.*Payment of Bonus Act*. Lucknow: Eastern Book Company.
- Srivastava K. D. *Payment of Wages Act*. Lucknow: Eastern Book Company.

- Srivastava S. C. *Treatise on Social Security*. New Delhi: Vikas Publishing House.

REFERENCE BOOKS:

- M.S Siddiqui, Cases and Materials on Labour Law and Labour Relation, Indian Law
- Institute, 1963
- ZMS Siddiqi and M.Afzal Wani, Labour Adjudication in India, ILI, 2001
- Kumar, H L. (2008) *Labour laws: Everybody should know*. New Delhi: Universal Law Publishing Co.Pvt.Ltd
- Kumar, H L. *Checklist obligation of employers under labour laws*. Delhi: Universal Law Publishing Co.Pvt.Ltd

LAW OF CRIMES-II (INDIAN PENAL CODE)

OBJECTIVE:

The purpose of the subject is to enable the students to understand the general principles of criminal liability, to identify the ingredients of an offence, understand the range of state of mind required for different offences. The primary objectives of this course are: - To acquaint the students with the key concepts of crime and criminal law, To expose the students to the range of mental states that constitute mens rea essential for committing acrime, To teach specific offences under the Indian Penal Code, To keep students abreast of the latest developments and changes in the field of criminal.

Credits: 06 **Trimester VIII** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
Module-I	**Offences against the Human Body: -**Culpable Homicide and Murder, Rash and Negligent act, Dowry Death, Attempt to Murder Attempt and Abetment to Suicide. Hurt and Grievous Hurt Criminal Force and Assault Wrongful Restraint and Wrongful Confinement Kidnapping and Abductions	**30**
Module-II	**Offences relating to Marriage:-**; Bigamy ,Adultery, Cruelty. **Offences relating to Property**: - Theft, Extortion, Robbery and Dacoity Criminal Misappropriation and Criminal Breach of Trust Cheating and Forgery Mischief. **Offences against Women** :-Outraging the Modesty of Women, *Voyeurism*, Stalking, Acid Attack Rape and Unnatural Offence	**30**

LEARNING OUTCOME:

The students will be able to understand the general principles of criminal law, key concepts, its application, offences against women and recent developments in the field of criminal law.

Focus: understand the general principles of criminal law

REFERENCE BOOKS:

- K.T. Thomas, M.A. Rashid (Rev.), **Ratan Lal & Dhiraj Lal's *The Indian Penal Code***, (34th ed., 2014)
- K.D. Gaur, Criminal Law: ***Cases and Materials***, (8th ed., 2015)
- R.C. Nigam, ***Law of Crimes in India*** (Vol. I) (1965)
- V.B. Raju, ***Commentary on Indian Penal Code***, 1860 (Vol. I & II) (4th ed., 1982)
- K.N.C. Pillai & Shabistan Aquil (Rev.), ***Essays on the Indian Penal Code*** (The Indian Law Institute, 2005) 6) K. I. Vibhute (Rev.), P.S.A. Pillai's ***Criminal Law*** (12th ed., 2014)
- Syed Shamsul Huda, ***The Principles of the Law of Crimes in British India*** (1902)
- **K.N. Chandrasekharan Pillai**, ***General Principles of Criminal Law***(2nd ed., 2011)

POLITICAL SCEINCE – INDIA'S FOREIGN POLICY AND RELATIONS

OBJECTIVE:

This paper seeks to equip students with the basic concepts of foreign policy. A key objective of the course is to make students aware of the key concept of International relations. This course's objective is to teach students the basic determinants and evolution and practice of India's foreign policy.

Credits: 05 **Trimester VIII** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
Module I	**Major theories of International Relations:** Realim, Idealism, Constructivism, Marxism. **Basic foundations of India's Foreign Policy:** Panchsheel Doctrine, **Non Alignment Movement (**NAM), Nehruvian Doctrine of foreign Policy The Cold War and India's foreign Policy **India and its Neighbours**	**24**
Module II	**India and Major powers**: US, China, Russia and Europe India and International Organization: UNO, WTO, BRICS, SCO India's post-Cold War foreign Policy: From NAM to Multi alignment era	**24**

LEARNING OUTCOME:

- A student will have a theoretical understanding of the International politics.
- The Student will be able to apply the theoretical understanding of IR in India's foreign policy.
- A student would have an understanding of India's linkages with major powers.

Focus: it will focus theoretical understanding of the International politics.

TEXT BOOKS:

- Brecher, Miachel, India and World Politics: Krishna Menon's View of the World, OUP, 1968, London
- Appadorai, A., Rajan, M.S., India's Foreign Policy and Relations, New Delhi, South Asian Publishers, 1985.
- **India's Foreign Policy: Retrospect and Prospect.** *Ganguly, S. (ed.) (2009) New Delhi: Oxford University Press.*

SUGGESTED READINGS:

- S. Cohen, (2002) India: Emerging Power, Brookings Institution Press.V. Sood, (2009) 'India and regional security interests', in Alyssa Ayres and C. Raja Mohan (eds), Power realignments in Asia: China, India, and the United States, New Delhi: Sage.
- C. Mohan, (2013) 'Changing Global Order: India's Perspective', in A. Tellis and S. Mirski (eds.), Crux of Asia: China, India, and the Emerging Global Order, Carnegie Endowment for International Peace: Washington.

BALC 4006: CIVIL PROCEDURE CODE I

OBJECTIVE:

Study of procedural law is important for a Law student. This course is designed to acquaint the students with the various stages through which a civil case passes through, and the connected matters.

Credits: 06 **Trimester IX** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	**Civil Procedure Code Introduction;** Distinction between procedural law and substantive law- History of the code, extent and its application, **definition:**-Judgment, Decree, preliminary and final Decree, orders, Means profit and Foreign Judgment. **Suits:** Jurisdiction of the civil courts- Kinds of jurisdiction-Bar on suits- Suits of civil nature (Sec.9); Doctrine of Res sub judice and Res judicata (Sec. 10, 11 and 12);Foreign Judgment (Sec. 13, 14);Place of Suits (Ss. 15 to 20); Transfer of Cases (Ss. 22 to 25).**Institution of suits and summons:** (Sec. 26, 0.4 and Sec. 27, 28, 31 and O.5); Interest and Costs (Sec. 34, 35, 35A, B); Pleading: Fundamental rules of pleadings- Plaint and Written Statement- Return and rejection of plaint- Defenses- Set off- Counter claim; Parties to the suit (O. 1): Joinder, misjoinder and non-joinder of parties- Misjoinder of causes of action- Multifariousness.	30
II	**Appearance and examination of parties** (O.9, O.18) – Discovery, inspection and production of documents (O.11 & O.13) – First hearing and framing of issues (O.10 and O.14) – Admission and affidavit (O.12 and O.19) – Adjournment (O.17) – Death, marriage-Insolvency of the parties (O.22) – Withdrawal and compromise of suits (O.23) – Judgment and Decree (O.20); Execution (Sec. 30 to 74, O.21): General principal of execution- Power of executing court- Transfer of decrees for execution- Mode of execution- a) Arrest and detention, b) Attachment, c) Sale.	30

Focus: various stages through which a civil case

TEXT BOOKS:

- Dinshaw Fardauzi Mulla, *Mulla's Code of Civil Procedure*, Lexis Nexis (18th Edn)
- Sudipto Sarkar & V.R. Manohar, *Sarkar's Code of Civil Procedure* (2 Vols), LexisNexis India (11th Edn)
- C.K. Takwani, *Code of Civil Procedure*, Eastern Book Company, Reprinted 2015
- M.R. Malik, *Ganguly's Civil Court, Practice and Procedure*, Eastern Law House, 2012
- *Universal's Code of Civil Procedure, 1908* (Bare Act)
- M.P. Tandon, *Code of Civil Procedure*, Allahabad Law Agency, 2005

REFERENCE BOOKS:

Ganguly – Civil Court, Practice and Procedure

M.P. Tandon – Code of Civil Procedure.

LEARNING OUTCOMES:

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

CO1: comprehend and explain key legal concepts underpinning civil law;
CO2: critically evaluate the challenges and debates surrounding Civil law;

CO3: identify, analyze and critically assess disputes between parties involving issues of civil dispute;
CO4: demonstrate legal problem-solving skills, which generate appropriate responses to complex statutory problems in the field of Civil Law;

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 4007: COMPANY LAW

OBJECTIVE:

The course is designed to understand the formation, management and other activity of the companies. In view of the changing facts of global governance corporate governance plays a vital role in the development of an economy both national and international level. The companies Act 1956 has not been repealed but certain provisions replaced by the new Act of 2013. The notified sections which replace the provisions of Companies Act 1956 will be highlighted. Accordingly, the paper aims to introduce to the students the nuance of corporate law and the obligations of it towards society in discharging its trade relations and to be a good corporate citizen. Therefore, the paper needs to be taught in light of the new companies Amendment Act 2013.

Credits: 06 **Trimester IX** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	Meaning of Company, Distinction between company and other associations, Nature and kinds of company, Formation, promotion and incorporation of companies, Promoters: Position, duties and liabilities, Mode and consequences of incorporation, Uses and abuses of the corporate firm, lifting of corporate veil, Theory of Corporate personality, Memorandum of Association: Meaning, purpose and contents, alteration and binding nature of memorandum of association, Doctrine of ultra vires, Articles of Association: Meanings, form and contents, binding nature, alteration, relation with memorandum of Association, Doctrine of Constructive Notice of Memorandum and Articles, Doctrine of Indoor Management and its exceptions. **Shares:** meaning and kinds of shares, allotment of shares, general principles regarding allotment, statutory restrictions on allotment, Statutory share certificate, its objects and effects, **Transfer of shares**: Procedure for transfer of shares and restrictions on transfer of shares, certification of transfer relationship between transferor and transferee, Share Capital, reduction of share capital	30
II	Directors: Kinds, Powers and Duties, Legal position of directors, Liabilities of directors, Role of nominee Directors	30

	,Managing Director and other managerial personnel. Meeting, Kinds and Procedure The balance of powers within companies Majority control and minority protection, Prevention of Oppression and Mismanagement. **Winding up of Companies** Kinds, Consequences and reasons of winding up of companies, Insolvency and Bankruptcy Code, Role of the Court in winding up of company Liability of past members Payment of liabilities Reconstruction and amalgamation Emerging trends in corporate social responsibility, legal liability of company-civil, criminal, tortuous and environmental	

TEXT BOOKS:

- Avtar Singh, (2018), Indian Company Law, Eastern Book Co, New Delhi.
- R.K. Bangia, (2018), Company Law, Allahabad Law Agency, Prayagraj.
- L.C.B. Gower, (2016), Principles of Modern Company Law, 1997 Sweet & Maxwell, London.
- Companies Act, 2013, Universal Law Publication, New Delhi.

REFERENCE BOOKS:

- A. Ramaiya, (2016), Guide to the Companies Act, Lexis Nexis, New Delhi.
- Palmer, Palmer's Company Law, 1987 Stevens, London.
- Gulshan, S.S., & Kapoor, (2018), G.K. Business Law including Company Law, New Age International Pvt. Ltd, New Delhi.
- Gogna, P.P., (2016), A Textbook of Company Law, Sultan Chand, New Delhi.

LEARNING OUTCOMES:

By the end of this course it is expected that the student will be able to:

CO1: Explain and apply to various fact scenarios the concept of separate legal entity.

CO2: To explain the basic documents such as MOA and AOA required for company.

CO3: To develop the ability to identify and effectively use the corporate law resources, to develop the ability to learn company law both independently and cooperatively in a professional environment.

CO4: To evaluate and analyze socially reasonable corporate behavior.

Focus: it analyze socially reasonable corporate behavior

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 4006: THE CODE OF CRIMINAL PROCEDURE -I

OBJECTIVE:

The criminal procedure code is designed to look after the process of the administration and enforcement of criminal law. Without the criminal procedure code the substantive criminal law will become worthless. The course is designed to make the students understand how the Criminal procedure code controls and regulates the working of the machinery set up for the investigation and trial of offences.

Credits: 06 **TRIMESTER-IX** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Introduction**: -(a)Object and Importance of Cr.P.C, **(b)**Functionaries under the Cr.P.C, **(c)Basic Concepts**: Bailable Offence, Non-Bailable Offence, Cognizable Offence, Non-cognizable Offence, Complaint, Charge, Police Report, Investigation, Inquiry and Trial, Summons Case, Warrant Case. **Arrest ,Bail and Pre-Trial Proceedings(a)** Arrest and Rights of an Arrested Person(b)Provision for Bail under the Code**(c)**Process to Compel Appearance of Person**(d)**Process to Compel Production of Things**(e)**Condition Requisites for Initiation of Proceeding**(f)**Complaint to Magistrate **(g)**Commencement of Proceeding before Magistrate.	30
II	**Trial Proceedings**: - (a)Framing of Charges and Joiner of Charge Jurisdiction of the Criminal Courts in Inquiries and Trials **.Types of trials:** Sessions Trial, Warrant Trial, Summons Trial, Summary Trial. **Judgment and Sentences** under the Code, Submission of Death Sentences for Confirmation. General Provisions as to Inquiries and Trial Execution, Suspension, Remission and Commutation of Sentences	30

TEXT BOOKS

- Ratanlal & Dhirajlal, *Criminal Procedure,* Lexis Nexis Butterworths Wadhwa, Nagpur,2012
- S.C. Sarkar, *The Law of Criminal Procedure,* Wadhawa &Co. , Nagpur,2007

REFERENCES:

- K.N. Chandrasekharan Pillai, *R.V. Kelkar's Lectures on Criminal Procedure,* Eastern Book Company,2013
- K.N. Chandrasekharan Pillai, *Criminal Procedure,* Eastern Book Company,2004
- Aiyer, Mitter, *Law of Bails- Practice and Procedure,* Law Publishers(India) Pvt. Ltd., 2012
- P.V. Ramakrishna, *Law of Bail, Bonds, Arrest and Custody,* Lexis Nexis,2008
- P.K. Majumdar, *Law of Bails, Bonds and Arrest,* Orient Publication,2012
- Justice P.S. Narayana, *Code of Criminal Procedure,* ALT Publications,2012
- *Bare Act of Code of Criminal Procedure,1973*

LEARNING OUTCOME:

CO1: The students will be able to appreciate the importance of criminal procedure and its applications in criminal justice system.

CO2: Students will be familiar with the Power, functions, and indispensable attributes in a civilized society, will be acquainted with stages of investigation and trail procedure thereof.

Focus: applications in criminal justice system

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2

BALC 4008: LAW OF TAXATION

OBJECTIVE:

To familiarize and update the students with the basic principles of Taxation, Structure of Indian Taxation system and provisions of direct tax.

Credits: 06 **Trimester IX** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	**Basic Concept**: Income, Agricultural Income, Causal Income, Assessment Year, Previous Years, Gross Total Income, Total Income; Tax Evasion, Tax Avoidance, Tax Planning **Basis of Change**: -Scope of Total Income; Residence and Tax Liability Income which does not fall part of total income. **Heads of Income**: -Salaries; Income from property; Profits or gains of business or profession, including provisions relating to specific business; Capital gains and income from otherSources. **Constitutional Provisions** and Fiscal Relation between Centre and States.	30
II	**Computation of Tax Liability: -**Computation of total income and tax liability of an individual, H.U.F., and firm; Aggregation of Income; Set off and carry forward of losses Sale. **Tax Management**: - Tax deduction at source; Advance payment of tax; Assessment Procedures; Tax planning for Individuals. **Tax Administration**: - Authorities; Appeals; Penalties **Indirect Tax Regime**:-IGST-Integrated GST(IGST) levied by the Central Government. Inter-state transactions and imported goods or service state gst (SGST), Impact of GST on state revenue, Indemnifying state revenue loss.	30

TEXT BOOKS:

- Singhanar V.K: Students' Guide to Income Fax; Taxmann, Delhi.
- Prasaci, Bhagwati: Income Tax Law & Practice: Wiley Publication, New Delhi,
- Mehrotra H.C: Income Tax Law & Accounts; Sahitya Bhawan, Agra.
- Dinker Pagare, Income Tax Law and Practice: Sultan Chand & Sons, New Delhi.
- Girish Ahuja and Ravi Gupta: Systematic approach to income tax: Sahitya Bhawan Publications, New Delhi.
- Chandra Mahesh and Shukla D.C.: Income Tax Law and Practice; Pragati Publications, New
- V.S. Datey, GST Ready Reckoner, Taxmann Publications (P.) Ltd., New Delhi, 6th Edition (2018)
- V.S. Datey, All About GST, a Complete Guide to New Model GST Law, Taxmann Publications (P.) Ltd., New Delhi, 5th Edition

Pathik Shah, Hand book on Good and Service Tax, Bharati& Co., 1st edition (2017); 4. Rajat Mohan, Guide to GST, Bharat Law House Pvt. Ltd., New Delhi, 2016; 5. GST Laws Manual: Acts, Rules and Forms.

LEARNING OUTCOMES:

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

CO1: Describe how the provisions in the Income tax laws can be used for tax planning.

CO2; Students of the subject will be able to explain different types of incomes and their taxability and expenses and their deductibility.

CO3: Students of the course will able to state the use of various deductions to reduce the taxable income.

Focus: provisions in the Income tax laws can be used for tax planning.

Mapping of Programme Educational Objectives with Course Outcomes

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COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
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CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

INSTITUTE OF LEGAL STUDIES AND RESERACH

GLA UNIVERSITY,

MATHURA (U.P.) INDIA

COURSE STRUCTURE

FOR

B.Com LL.B. (Hons.)

First Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 0001	1.	Constitutional Law-I	4	2	2	6	8
BALC 0002	2.	Law of Torts including MV & Consumer Protection Laws	4	2	2	6	8
BCLC 0001	3.	Principles of Management	4	1	1	5	6
BELH 0010	4.	General English – I	4	1	1	5	6
		TOTAL	**16**	**6**	**6**	**22**	**28**

Second Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 0007	1	Constitutional Law-II	4	2	2	6	8
BCLC 0002	2.	Financial Accounting	4	1	1	5	6
BCLC 0003	3.	Management Accounting	4	1	1	5	6
BELH 0011	4.	General English – II	4	1	1	5	6
		TOTAL	**16**	**5**	**5**	**21**	**26**

Third Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BCLC 0004	1.	Auditing	4	1	1	5	6
BCLC 2005	2.	Business Statistics	4	1	1	5	6

BCLC 2006	3.	Corporate Accounting – I	4	1	1	5	6
BCLC 0006	4.	Legal Language & Communication Skills	4	2	2	6	8
		TOTAL	**16**	**5**	**5**	**21**	**26**

Fourth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 1002	1.	Law of Contract-I	4	2	2	6	8
BALC 1001	2.	Jurisprudence-I	4	2	2	6	8
BALC 1003	3.	Family Law-I	4	2	2	6	8
BCLC 2007	4.	Corporate Accounting – II	4	1	1	5	6
		TOTAL	**16**	**7**	**7**	**23**	**30**

Fifth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 2002	1.	Law of Contract-II	4	2	2	6	8
BALC 2001	2.	Jurisprudence-II	4	2	2	6	8
BALC 2003	3.	Family Law-II	4	2	2	6	8
BCLC 1008	4.	Managerial Economics – I	4	1	1	5	6
		TOTAL	**16**	**7**	**7**	**23**	**30**

Sixth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 2004	1.	Interpretation of Statutes	4	2	2	6	8
BCLC 2009	2.	Principles of Taxation	4	1	1	5	6
BCLC 2008	3.	Managerial Economics-II	4	1	1	5	6
BALC 2005	4.	Legal Hindi	4	1	1	5	6
		TOTAL	**16**	**5**	**5**	**21**	**26**

Seventh Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 3001	1.	Law of Crimes-I	4	2	2	6	8
BALC 3003	2.	Labour Law-I	4	2	2	6	8
BALC 3002	3.	Property & Easement Law	4	2	2	6	8
BCLC 3001	4.	Cost Accounting	4	1	1	5	6
		TOTAL	**16**	**7**	**7**	**23**	**30**

Eighth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 4001	1.	Law of Crimes-II	4	2	2	6	8
BALC 4003	2.	Labour Law-II	4	2	2	6	8
BALC 4002	3.	Administrative Law	4	2	2	6	8

BCLC 4004	4.	Principles and Practices of Banking and Insurance	4	1	1	5	6
		TOTAL	**16**	**7**	**7**	**23**	**30**

Ninth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 4005	1.	Criminal Procedure Code- I	4	2	2	6	8
BALC 4006	2.	Civil Procedure Code-I	4	2	2	6	8
BALC 4007	3.	Company Law	4	2	2	6	8
BALC 4008	4.	Laws of Taxation	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Tenth Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 5005	1.	Criminal Procedure Code- II	4	2	2	6	8
BALC 5006	2.	Civil Procedure Code-II	4	2	2	6	8
BALC 5007	3.	Public International Law	4	2	2	6	8
BALC 5008	4.	Environmental Law	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Eleventh Trimester

SUBJECT CODE	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
BALC 6001	1.	Law of Evidence- I	4	2	2	6	8
BALC 6002	2.	Sports Law	4	2	2	6	8
BALC 6003	3.	Anti-Corruption Money Laundering Laws	4	2	2	6	8
BALC 6004	4.	Cyber Law	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Twelfth Trimester

	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
	1.	Law of Evidence- II	4	2	2	6	8
	2.	Elective- III	4	2	2	6	8
	3.	Elective- IV	4	2	2	6	8
	4.	Honours-II	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Thirteenth Trimester

	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
	1.	Elective- V	4	2	2	6	8
	2.	Elective- VI	4	2	2	6	8
	3.	Honours-III	4	2	2	6	8

	4.	Honours-IV	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Fourteenth Trimester

	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
	1.	Honours- V	4	2	2	6	8
	2.	Honours-VI	4	2	2	6	8
	3.	Clinical-I (Drafting's&Pleadings)	4	2	2	6	8
	4.	Clinic-II (Alternative Dispute Resolution)	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Fifteenth Trimester

	S. NO	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
	1.	Honours- VII	4	2	2	6	8
	2.	Honours-VIII	4	2	2	6	8
	3.	Clinical-III (Professional Ethics)	4	2	2	6	8
	4.	Clinical-IV (Moot Court)	4	2	2	6	8
		TOTAL	**16**	**8**	**8**	**24**	**32**

Honour's Courses

1. **Corporate &Business Law Group**
   - H-I Cyber Law
   - H-II Data Privacy

H-III Intellectual Property Law- I
H-IV Intellectual Property Law- II
H-V Law of Mergers and Acquisitions
H-VI Banking Law
H-VII Insurance Law
H-VIII Finance Law

ELECTIVE COURSES

Elective - I

- Sports Law

Elective - II

- Anti- Corruption and Money Laundering Laws

Elective-III

- Competition Law

Elective-IV

- Law of Infrastructure Development and Real Estate

Elective-V

- Media Law

Elective-VI

- International Commercial Arbitration

BALC 1001: CONSTITUTIONAL LAW OF INDIA- I

OBJECTIVE:

The objective of this paper is to provide the understanding of fundamental rights and duties, perspective and remedies. Students will be able to understand the nature of the State, relationship between Fundamental rights and Directive Principles of State Policy.

Credits: 06 **Trimester I** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
Module-I	Characteristics of the Indian Constitution. Special emphasis shall be placed on (A) Federal Structure and (B) form of Government. **Preamble.** Fundamental Rights-General Scheme of fundamental Rights, who can claim fundamental rights: Against whom fundamental rights are available? Suspension of fundamental Rights. Definition of 'State' for enforcement of fundamental rights: Justifiability of fundamental Rights. Doctrine of Eclipse, Severability, Doctrine of Waiver.(Art.12 &13) Right to Equality (Arts-14-18): Doctrine of Reasonable classification and the principles of Absence of Arbitrariness, Principle of compensatory discrimination. Fundamental freedom (Article 19): Freedom of Speech and Expression (a) Freedom of press.Art.19 (1)(a).	**30**
Module-II	Fundamental Rights – Double Jeopardy, Right to Life and Personal Liberty, Protection against Illegal Arrest and Detention (Articles20,21,22): Scope and content (Expensive Interpretation-Right to Privacy, Live in Relationships etc) Right against exploitation (Article 23-24): Forced Labour, Child Employment and Human Trafficking. Freedom of Religion and Cultural Educational Right of Minorities(Art. 25-30), Right to Constitutional Remedies: - Writs Habeas corpus, mandamus, certiorari, prohibition and Quo-Warranto, Art. 32 and 226, Judicial Review. Directive Principles. Art. (37-51)-Nature and Justifiability of the Directive Principles. Inter-Relationship between Fundamental Rights and Directive Principles. Fundamental Duties.(Art.51A), Amendment of the constitution. Power and Procedure, Basic Structure of the Constitution.(Art.368)	**30**

REFERENCE BOOKS:

- D.D. Basu, Shorter Constitution of India, 15th Edition 2018, Lexis Nexis, Nagpur
- Shukla, V.N., Constitution of India, Lucknow: Eastern Book Co.
- J.N. Pandey, Constitution of India., 47th Edition., Central Law Agency, 2014.
- P.M. Bakshi, Constitution of India. 12th Edition., Universal Publishing House, 2013.
- M.V. Pylee, Constitutional Government in India, Asia Publishing House.
- Seervai H.M. Constitutional Law of India.
- M.P. Jain, Constitutional of India, Wadhwa Nagpur.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Students will be able to understand the philosophy of Fundamental Rights in the supreme law of land and its enforcement

CO2: Understand the process of issuance of different writs.

CO3: Understand amending power of parliament of Constitution.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**

CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

BALC 0002: LAW OF TORTS INCLUDING MV AND CONSUMER PROTECTION LAWS

Objective:*Tort is a civil wrong, i.e. a legally harmful act or omission. The course aims at introducing the law of tort to the student so that the student can take it up for practice or further study.*

Credits: 06 **L-T-P: 5-1-0**

Semester I

Module No.	Content	Teaching Hours
I	Tort, Nature and Definition of Torts, Tort and Crime, Tort and Contracts, Tort and Breach of Trust, Elements of Tort, Mental Element in Tort, Malice in Law and Malice in Tort, Misfeasance and Malfeasance, Foreign Torts. General Defences, Capacity, Vicarious Liability.	20
II	Death in Relation to Torts, Discharge of Torts, Remedies, Torts Against Person, Defamation, Malicious Prosecution, Torts against Property, Negligence, Nuisance, Liability	20
III	Consumer Protection Act: Aim and objective of the Act, Definition, Rights of consumer, Consumer Protection Council, Complaints and process of making Complaints, Composition, Power, Function and Jurisdiction of consumer Disputes, Redressal Agencies, Reliefs. Motor Vehicle Act, 1988: Objects and Reason, Definitions, Licensing of Drivers of Motor Vehicle Registration of Motor Vehicles, Liability without fault in certain cases, Insurance of Motor Vehicle against third Party risk	20

Recommended Readings

- Singh, P. S. A.Pillai's Law of Tort (Lucknow: EBC, 2010).
- C. Walton, ed., Charlesworth & Percy on Negligence (London: Sweet & Maxwell, 2011)
- D. G. Owen, The Philosophical Foundations of Tort Law (London: OUP, 1999).
- F V Robert and R. A. Buckley, Salmond and Houston on the Law of Torts (London: Sweet & Maxwell, 1996).
- J. Murphy, The Law of Nuisance (London: OUP, 2011).
- P.A. Dugdale, Clerk & Lindsell on Torts (London: Sweet & Maxwell, 2011).

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Know the principles of tort and its implication.

CO2: Acquainted with the knowledge of about tortious liability.

CO3: Gain knowledge of different kinds of tortious liability and will be aware about their civil rights.

CO4: Understand the rights and duties of consumer and about the consumer jurisdiction and forum.

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

Mapping of Programme Educational Objectives with Course Outcomes

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CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
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CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BELH 0001: GENERAL ENGLISH- I

Objective*:* *The course aims at familiarizing the students with English language sound system to enhance their power of articulation. It provides intensive practice and extensive exposure to listening, speaking, reading and writing skills. It would enhance not only their comprehensive knowledge of vocabulary but also strengthen their all four skills. The design and content of the course are aimed at making students gain language proficiency and also to improve their communication skills.*

Credits: 06 **L-T-P: 5-1-0**

Semester I

Module No.	Content	Teaching Hours
I	Basics of Communication: The channels/ networks, forms, factors and process of Communication, Verbal & Non-Verbal Communication techniques, Body Language and its various forms, Barriers to Communication, types and ways to overcome them. Art of Conversation: Participate well in the art of conservation, qualities of a good conversationalist, Practice the voice modulation techniques using appropriate body language. English Language Phonetic System: Sound system classification and features, Syllable Structure, acquire correct pronunciation & accent by overcoming specific speech problems. Reading Skill: The mechanics, techniques and types of Reading, Develop the ability to infer and interpret the text, Know the traits of reading to improve speed and vocabulary. Listening Skill: Know the importance and techniques of improving listening skill, Cognitive process, Homophones and Homonyms, learn how to overcome the Listening barriers.	20
II	Vocabulary Extension: Learn to identify and convey the finer shades of meaning with accuracy, Synonyms, Antonyms, and one-word substitutes, Practice the methods of Vocabulary expansion, Word formation and word analysis techniques, Commonly confused words, Legal Terminology. Grammar: Subject, Verb agreement, Tenses and their forms, Acquire the ability to analyse the sentence syntactically. Prepositional Phrases: Know the various relationships expressed by specific use of Prepositions, Develop the competence in using idiomatic combinations, use correct Preposition after a verb, adjective and noun depending on the meaning. Phrasal Verbs: Separable & Inseparable, Learn the several verb combinations with distinct meanings, Practice using Phrasal Verbs effectively.	20
III	Effective Use of Words & Sentences: Understand the principles to be applied in selecting words, identify redundancy and learn to avoid cliché and vague words, Express the ideas clearly by using words effectively, Sentence structure and types. Subordination & Coordination, Active & Passive, Parallel Constructions, and Principles of constructing effective sentences. Effective Paragraphs: Principles of Effective Paragraphs Learn how to build Effective Paragraphs through Unity, Coherence and Emphasis, Acquire the skill of writing effectively. Business Correspondence: Business Letters: Structure, Components	20

	and Formats. Types of Business Letters and their essential features, Develop the skill of drafting Enquiry letters, Quotation letters, Order letters, Acknowledgement letters, Cover letters, etc., Learn effective beginnings and closings of these letters, Gain proficiency in writing business letters concisely, naturally, clearly and positively. Oral Presentations: Learn how to prepare the Presentations, know how to master the various techniques of effective speech delivery along with practice, learn how to manage question & answer session.	

Recommended Readings

- Aruna K. Dr., Professional Communicator, Tata McGraw, Hill Education Private Limited, 2008.
- Hornby A.S., Oxford Advanced Learner's Dictionary. Oxford University Press.
- Daniel Jones, Cambridge English Pronouncing Dictionary. Cambridge University Press.
- Quirk R. Greenbaum S., Leech G. and Svartik J., A Comprehensive Grammar of the English Language, Longman, London.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Use grammar rules in English conversation.

CO2: Learn the art of conversation with English Language Phonetic System.

CO3: Learn basic skills for written and oral communication in English.

CO4: Understand the commerce and trade activities in the society.

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

Mapping of Programme Educational Objectives with Course Outcomes

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	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

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COURSE OUTCOMES	PROGRAM SPECIFIC OBJECTIVES			
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CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 2001: JURISPRUDENCE-II (INDIAN LEGAL SYSTEM)

Objective*:* *The Indian legal system represents Indian laws, judicial institutions and legal traditions. The course introduces the Indian legal system to the student preparatory to studying particular branches of law.*

Credits: 06 **L-T-P: 5-1-0**

Semester II

Module No.	Content	Teaching Hours
I	The concept of legal system and main types of legal systems in the world, Nature and functions of a legal system. Legal system in the ancient India: The Hindu period, Legal system in the medieval India: The Mughal period, origin of the modern Indian legal system: The colonial period, the Mayors Courts: Genesis, working, defects, The Adalat System: Grant of Diwani, execution of Diwani, functions, reorganization of Adalats in 1780, the first civil code, reforms in the administrations of criminal justice.	20
II	Supreme Courts at Calcutta, Madras and Bombay: Law and administration of justice. Establishment of the High Courts: The Indian High Courts Act 1861. Allahabad High Court the Indian High Courts ACL 1911, the Government of India Act 1915: Other High Courts, Government of India Act 1935: Jurisdiction of High Courts, post-constitutional developments. The Federal Court of India: Establishment of the Federal Court, jurisdiction, authority of law, expansion of jurisdiction, abolition of the Federal Court: Functioning and evaluation	20
III	Privy Council: Jurisdiction, appeals from India, evaluation, The Supreme Court of India: Origin, appointment of judges, jurisdiction and powers, doctrine of precedent, evaluation, Indian legal profession: British legacy, salient features of the Advocates Act, 1961, evaluation, Nyaya Panchayat in India: Rationale, the Gram Nyayalayas Act, 2008. functioning and evaluation, Lok Adalat in India: Rationale, functioning and evaluation, Legal aid in India: Constitutional basis, the Legal Services Authorities Act, 1987, object and reasons, evaluation, Contemporary issues: Judicial reforms: Judicial appointments, procedural transparency: E-filing and live telecast of court hearings, measures to curb systemic delays, judicial accountability	20

Recommended Readings

- B. Abel-Smith and R. Stevens, Lawyers and the Courts (London: Heinemann, 1967).
- J. A. G. Griffith, The Politics of the Judiciary (London: HarperCollins, 1997).
- J. D. M. Derrett, An introduction to Legal Systems (New Delhi: Universal, 2011).
- J. Minattur, Indian Legal System (New Delhi: Oceana Publications, 2006).
- J. Raz, The Concept of a Legal System (London: OUP, 1980).
- K, Malleson and R. Moules, The Legal System (London: OUP, 2010).
- M. Hidayatullah, Democracy in India and Judicial Process (New Delhi: Asia Publishing 1966).

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Adopt a pragmatic approach in studying law.

CO2: Read, analyse and understand legal writings, and to narrate the reasoning employed by judges in their judgements

CO3: Discuss the important the fundamental concepts underlying the Indian law

CO4: Distinguish between the different types of laws

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

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 0006: LEGAL LANGUAGE AND COMMUNICATION SKILLS

Objective*:* *Legal English communicates legal meaning in the English language. The course aims at helping the students understand legal English and acquire the skills of communication in legal English.*

Credits: 06 L-T-P: 5-1-0

Semester II

Module No.	Content	Teaching Hours
I	Communication: Meaning, development and approaches, forms of communication: oral and written, passive and active listening, the role of communication. The relation of Law to language: meaning and explanation with reference to relevant legal texts, origin of legal English: Examples from Latin: Legal Maxims.	20
II	Growth of legal English: Introduction to the legal and Constitutional history of England, The emergence of plea roles and law reports, manifestations of legal English: Legal terminology: Examples from legal texts: Constitution, Statues, treaties, Judgments, Characteristics of legal English: Legal usage: Examples from legal texts. Identifying legal English communication: class exercise from legal texts: Constitution, statutes, treaties, judgments	20
III	Understanding of legal English Communication: Explanation of legal words and phrases from the discussion of legal texts: Constitution, Statutes, judgments, The importance of communication in legal profession: Discussion of landmark pleadings and legal briefs, Discussion of landmark judgments and advisory opinions: Class exercise: Mock pleadings, judgments and legal briefs writing, Simplifying legal English communication: Analysis of legislation and judgments and class exercise, The role of grammar, Legal writing exercises.	20

Recommended Readings

- A. Marmor and S. Soames, Philosophical Foundations of Language in (London: OUP, 2011).
- B. Bix, Law, Language and Legal Determinacy (London: OUP, 1995).
- B. Garner, Garner's Dictionary of Legal Usage (London: OUP, 2011).
- C. Williams, Tradition and Change in Legal English (New York: Peter Lang, 2005)
- E. Finch and S. Falinski, Legal Skills (London: OUP, 2011).
- E. Mertz, The Language of Law School (London: OUP, 2007).
- F. W. Maitland, The Constitutional History of England (NewDelhi: Vikas, 1987).

Focus: This course focuses on skill development aligned with all Cos

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	PROGRAMME EDUCATIONAL OBJECTIVE			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	PROGRAM SPECIFIC OBJECTIVES			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BCLC 0001: PRINCIPLES OF MANAGEMENT

Objective*:* *The objective of this paper is to helps students to acquire knowledge of the Business & Management. World trade and business today relies heavily on the skill and acumen of management experts This paper shall introduce students to the basic principles of management and its application to day to activities.*

Credits: 05 **L-T-P: 5-0-0**

Semester I

Module No.	Content	Teaching Hours
I	Introduction: Concept and Evolution of Management, Importance, Functions, Management Art or Science? Roles and Function of Manager Management vs Administration, Levels of Management, Theories of Management – Classical & Neo – Classical.	20
II	Planning &Organizing- Nature, Importance, objectives Types of Planning, Steps in Planning, planning Premise – MBO, Strategies, policies, Decision Making, SWOT & TOWS Matrix, Organizing Process, Principals, Formal & Informal, span of Management, Organization structure – Line, staff, matrix, Authority & Power, Centralization & Decentralizations. Delegation.	20
III	Staffing Concepts, Importance, need, Recruitment & Selection, Process, Techniques, Training – on the job, off the job, Internal & External, Directing – concept. Effectiveness, motivation- Types and theories, leadership theories, role of leader and manager Controlling – Concept, Types of control, Methods of control need of Control, benefits & problem of control –conflict – stages, type, causes, Consequences and Prevention	20

Recommended Readings

- Charles W L Hill, Steven McShane, Principles of Management, Mc Graw – Hill, 2007
- Harold Koontz and Cyril O Donnell, Principles of Management an Analysis of managerial Functions, McGraw Hill Book Company, New Delhi, 2004
- Gupta C.B Principles of Management, Sultan Chand & Sons, New Delhi. 2013
- Prasad L. M Principles and practice of management. New Delhi: Chand & Sons.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Acquire knowledge of the Business & Management, World Trade and Business.

CO2:Understand various skill and acumen of management experts.

CO3: Learn basic principles of management and its application to day-to-day activities.

CO4: To help the students to develop cognizance of the importance of management principles.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BCLC 0002: FINANCIAL ACCOUNTING

Objective*:**Any course or syllabus of B. Com shall be incomplete if it does not encompass the subject of financial accounting. Financial accounting is the cornerstone for commerce and trade activities the students shall get first- hand knowledge of the principles of the accounting system by virtue of this module.*

Credits: 06 L-T-P: 5-1-0

Semester I

Module No.	Content	Teaching Hours
I	Introduction: Meaning Need Characteristics Stages Objectives, Difference between Accounting, Accountancy and Book Keeping Functions Branches Limitations Advantages or Role of Accounting Generally Accepted Accounting Principles (GAAP), Accounting Standards, Accounting Equations Users of Accounting Information. Journal: Meaning, Objectives Advantages and Limitations; Sub Division of Journal: Journal Proper and Special Journal (Purchase Book Sales Book, Purchase Return Book Sales Return Book Bills Payable Books & Bills Receivable Books.) Cash Book: Meaning Types of Cash Book (Simple, Double Column and Triple Column) and Petty Cash Book Preparation of Cash Book Classifications & Summarizations of Transactions	20
II	Ledger: Meaning Format Ledger Posting Difference between Journal & Ledger Trial Balance Meaning Objectives, Method of Preparing Analysis and Interpretation of Transactions (Preparation of Trial Balance or Rectification of Trial Balance, Advantages and Limitations.	20
III	Final Accounts: Meaning, Trading and profit & Loss Accounts Balance Sheet Limitations Precautions while preparing Final Accounts and Manufacturing Accounts Adjustments: Closing Stock Outstanding Expenses, Prepaid Expenses Accrued Income Unearned Income Depreciations Bad Debts, Provision for Bad Debts and Doubtful Debts Provision for Discounts on Debtors, Reserve for Creditors Interest on Capital Interest on Loan & Interest on Loan Numerical Preparation of Final Accounts with Adjustments. Accounting for Higher Purchase and Partnership Firm (Simple Numerical Problems)	20

Recommended Readings

- Paresh Shah: Basic Financial Accounting for Management, Oxford University Press
- Bhattacharya S K Accounting for Management Text and Cases Vikas Publishing House New Delhi
- Bhattacharya H How to Read a Balance Sheet Adapted to Indian laws & requirements" Oxford an IBH Publishing Company Pvt. Ltd
- Maheswari&Maheswari, Accounting for Managers Vikas Publishing New Delhi
- Grewa; T S Introduction to Accountancy New Delhi: S. Chand & Co.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Develop cognizance of the importance of accounting in organization financial statements

CO2: Describe how people analyse the corporate financial under different conditions.

CO3: Gain the knowledge of the principles of the accounting system by virtue of this paper.
CO4: Understand the commerce and trade activities in the society.

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

Mapping of Programme Educational Objectives with Course Outcomes
A broad relation between the Programme Objective and the outcomes is given in the following table:

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BCLC 0003: MANAGEMENT ACCOUNTING

Objective*:* *The objective of this paper is to help students to develop an understanding of management accounting and to expose the students to the latest techniques of management accounting which are useful in the process of managerial decision making in today's dynamic business world.*

Credits: 06 **L-T-P: 5-1-0**

Semester II

Module No.	Content	Teaching Hours
I	Introduction: Meaning, Concept, Nature, Scope, Objectives and limitations of Management accounting, Distinction between Management accounting, Financial accounting, and cost accounting. Tools and techniques of Management accounting. Financial Analysis: Meaning, Objectives and limitations, techniques of financial analysis/ comparative analysis, common size statement, trend analysis. Long term investment decisions, financing decisions, dividend decisions.	20
II	Ratio analysis: Meaning and importance of ratio analysis, profitability ratio- gross profit and net profit ratio, activity ratio stock, debtors, creditors and capital turnover ratio, liquidity ratio current and quick ratio, solvency ratio-debt equity ratio, capital gearing ratio and interest coverage ratio.	20
III	Cash Flow Analysis: Meaning, difference between funds flow and cash flow statement, Utility of cash flow statement, limitation of cash flow statement, presentation of format of cash flow statement as per AS-3 .Cost-volume-profit analysis; Meaning of marginal costing, fixed and variables elements of costs. Concepts of contribution, cost-volume-profit analysis, profit-volume-ratio (P/V RATIO) and break-even analysis, margin of safety, importance of CVP, P/V and break-even analysis.	20

Recommended Readings

- Bhattacharyya S. K. & Dearden J., Accounting for Management, Vikas Publication.
- Kishore Ravi M, Advanced Management Accounting, Taxmann
- Khan & Jain, Management Accounting, Tata McGraw-Hill
- Pandey, I. M., Management Accounting, Vikas Publication

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Define operation and capital budgeting, and explain its role in planning, control and decision making.
CO2: Prepare an operating budget, identify its major components, and explain the interrelationships among its various components.
CO3: Use appropriate financial information to make operational decision.
CO4: Identify the role and scope of financial and managerial accounting.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BCLC 0004: AUDITING

Objective*:* *This paper is helpful for the students to acquire conceptual knowledge of the auditing and it will impart skills for doing auditing work in various kinds of Profit and Non- Profit Organization.*

Credits: 05 **L-T-P: 5-0-0**

Semester II

Module No.	Content	Teaching Hours
I	Introduction: Auditing- Meaning & definition, objectives, features, origin & evolution, basic principles, techniques, advantages scope, limitations and classification. Difference between Accountancy & auditing and Auditing & investigation, internal control, internal check, internal audit, internal control and auditor, concept of true and fair view	20
II	Procedure of Auditing: Audit process- Preparation before the commencement of audit, Audit plan, Audit program, Audit file, Audit note book, Audit working papers, Audit procedure- Tick marks, routine checking, test checking, audit in depth and overall checking, voucher, vouching, verification and valuation of Assets and Liabilities, difference between vouching and verification	20
III	Company Audit: Qualifications & disqualifications, ceiling limit, appointment, removal, remuneration, rights and duties, legal status of auditor, class of auditor, auditor report-content and type. Nature and Significance of Cost, Tax, Management, Environment and Social Audit etc. Recent trends in Auditing: Nature and Significance of Cost Audit, Tax Audit, Management Audit.	20

Recommended Readings

- Institute of Chartered Accountants of India, "Auditing and Assurance Standards", ICAI, New Delhi
- Ghatalia, S.V, "Practical Auditing ", Allied Publishers Private Ltd, New Delhi
- Basu, S.K., "Auditing Principles and Techniques", Pearson Education

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Articulate knowledge of fundamental audit concepts.
CO2: Apply critical thinking skills and solve auditing problems through the use of case studies.

CO3: Understand the auditing practices so as to confirm the successful management and leadership of profit and not-profit organizations in a changing environment.
CO4: Equip with a broad range of knowledge, skills, and attitudes to help them understand the nature of auditing.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BCLC 0005: BUSINESS STATISTICS

Objective:*The learning of Business Statistics is of paramount importance particularly in its relation to economics, management sciences and industry. The various concepts of business statistics are directly applicable to the modules of economic, management sciences and industrial parameters. This course shall introduce the students to detailed statistical methods.*

Credits: 06 **L-T-P: 5-1-0**

Semester II

Module No.	Content	Teaching Hours
I	Concept, significance & Limitation Type of Data, Classification & Tabulation, Frequency Distribution & graphical & diagrammatical representation. Measures of Central Tendency (Mean, Medium, Mode)	20
II	Measures of Dispersion: Range, quartile deviation, mean deviation, standard deviation, skewness and kurtosis, correlation and regression: Introduction of correlation, types of correlation, Karl Pearson coefficient of corelation. Introduction of regression, regression lines and Regression coefficients.	20
III	Sampling and Hypothesis: Introduction, Method of sampling, sampling and non- sampling errors, procedure of testing the hypothesis, Type I and Type II errors, Chi-square test and their applications.	20

Recommended Readings

- Business Statistics; Mr. R. S. Bharadwaj, pub: Excel Book
- Business Statistics by Richard Levin
- Business Statistics by Ken Black, pub: Tata Macgraw Hill
- Schaum's Series for problem practice
- Mathematical Statistics by Ray, Sharma and Choudhary
- Business Statistics; V. K. Kapoor, pub: S. Chand

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: Critically evaluate the underlying assumptions of analysis tools.
CO2: Discuss critically the uses and limitations of statistical analysis.
CO3: Conduct basic statistical analysis of data.
CO4:Describe and discuss the key terminology, concepts tools and techniques used in business statistical analysis.

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

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 0007: CONSTITUTIONAL LAW OF INDIA- II

Objective*:* The students will be abreast of foundation philosophy of Constitution, nature and working of the Constitution, source of powers. The course will enable the students to critically evaluate and scrutinize the various provision of the Constitution of India.

Credits: 06 **Semester II** **L-T-P: 5-1-0**

Module No.	Content	Teaching Hours
Module-I	. **Union Parliament**: organization, Qualification for membership of parliament, Duration, powers. Privileges of its members. Procedure regarding enactment of Legislation. **Union Executive: The president**- his Position and powers including ordnance marking Power and to grant pardon etc. **Governor:** Appointment, Qualification, terms off office and powers including ordinance making power and to grant pardon, etc. **Prime Minister and cabinet:** Is the Prime Minister real head? Council of ministers? Collective Responsibility.	**30**
Module-II	**Union Judiciary:** Appointment of Judge transfer, removal, Promotion Independence of Judiciary. **Jurisdiction:** Original, Appellate, Advisory, Court of record, Judicial review. **State Judiciary:** Appointment of Judge of High Court , Transfer, Removal Promotion, Jurisdiction. **Distribution of powers between centre and States:** Legislative, Administrative and Financial Relationship between union and the states. Territorial and topical distribution of powers of Parliament to legislate on the state matters. Doctrine of Territorial nexus, doctrine of pith and Substance, Doctrine colourable legislation. **Emergency Provision:** With special reference to proclamation of National emergency and President Rule. **Freedom of Trade, Common and Intercourse.**	**30**

REFERENCE BOOKS:

- D.D. Basu, *Shorter Constitution of India* 15th Edn. 2018, Lexis Nexis, Nagpur
- Shukla V.N. *Constitution of India*, Lucknow: Eastern Book Co.

- J.N. Pandey, *Constitutional Law of India* 47th Edn. Central Law Agency, 2014
- P.M. Bakshi *Constitution of India* 12th Edn. Universal Publishing House. 2013
- M.V. Paylee *Constitution Government in India*, Asia Publishing House
- Seervai H.M. *Constitutional Law of India*.
- M.P. Jain Constitution of India. Wadhwa Nagpur
- Glanville Austin, Indian Constitution- Cornerstones of the Nations, Oxford University press,1999.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

CO1: understand the factual and theoretical knowledge of the nature and working of Indian Constitution
CO2: working of the three organs of state
CO3: legislative procedure, Judicial review and Independence of Indian judiciary.

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

Mapping of Programme Educational Objectives with Course Outcomes
A broad relation between the Programme Objective and the outcomes is given in the following table:

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

Mapping of Program Specific Objectives with Course Outcomes
A broad relation between the Program Specific Objectives and the outcomes is given in the following table:

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

GENERAL ENGLISH-II

OBJECTIVE:
The course aims at familiarizing the students with effective use of words and sentences, effective writing of paragraphs, Business correspondence and oral presentations skills.

Credits: 05 **Trimester II** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
Module I	**Phrasal Verbs:** Separable & Inseparable, Learn the several verb combinations with distinct meanings, Practice using Phrasal Verbs effectively. **Effective Use of Words & Sentences**: Understand the principles to be applied in selecting words, identify redundancy and learn to avoid cliché and vague words, Express the ideas clearly by using words effectively, Sentence structure and types, Subordination & Coordination, Active & Passive, Parallel Constructions, Principles of constructing effective sentences. **Effective Paragraphs:** Principles of Effective Paragraphs, Learn how to build Effective Paragraphs through Unity, Coherence and Emphasis, Acquire the skill of writing effectively. **Business Correspondence:** Business Letters: Structure, Components and Formats, Types of Business Letters and their essential features, Develop the skill of drafting Enquiry letters, Quotation letters, Order letters, Acknowledgement letters, Cover letters, etc., Learn effective beginnings and closings of these letters, Gain proficiency in writing business letters concisely, naturally, clearly and positively.	**24**
Module II	History of Legal English **Spotting Errors:** Punctuation Vocabulary: spellings and Derivation of Latinate Words Syntax: Analysis of Simple, Complex and Compound Sentence Reading: Act-IV, Scene I, Merchant of Venice: A Court of Justice by William Shakespeare, Discourse analysis by students. Recommended Movie: Merchant of Venice (2004) directed by Michael Radford **Presentation Strategies:** Individual/Group Presentations Learn how to prepare the Presentations, Know how to master the	**24**

	various techniques of effective speech delivery along with the practice, Learn how to manage question & answer session.	

Focus: This course focuses on skill development aligned with all Cos

LEARNING OUTCOMES:

Students will have skills to write proper formal professional English.

Students will learn how to use the right words and phrases for effective writing.

SUGGESTED READINGS:

- Aruna K. Dr., Professional Communication, Tata McGraw, Hill Education Private Limited, 2008.
- Hornby A.S., Oxford Advanced Learner's Dictionary, Oxford University Press.
- Daniel Jones, Cambridge English Pronouncing Dictionary, Cambridge University Press.
- Quirk R., Greenbaum S., Leech G. and Svartik J., A Comprehensive Grammar of the English Language, Longman, London.

LAW OF CONTRACT – I

OBJECTIVE:

This course will discuss the primary purpose of contract law, is to enforce the agreement of the parties. For there to be a contract, substantial agreement must exist and the parties must have freely intended to be legally bound. A breach occurs when one party foils the intentions of the other party. It will be helpful to the students to acquire the knowledge and how Contract as formed and its essentiality.

Credits: 06 **Trimester IV** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	**Formation of Contract-** Agreement and Contract- Definitions –Offer/Proposal and Acceptance: Definition, Communication, General/Specific offer, Cross offer, Counter offer, Invitation of treat- Tenders, Standard form of Contract. **Consideration-** Nudum Pactum- Essential elements- NO Consideration No Contract **Privities of Contract-** Unlawful Consideration and its effect. **Capacity to Contract-** Minor's Agreements and its effects- Persons of Unsound mind- Persons disqualified by Law.	30
II	Free Consent- Coercion –Undue Influence- Misrepresentation – Fraud – Mistake- Legality of Object- Void Agreement – Agreement- against Public Policy- wagering Agreements- Its exceptions- Contingent Contracts. Effect of Void- Voidable, Valid illegal, unlawful and uncertain agreement/ contracts. Discharge of Contracts and its various Modes- by performance – By operation of Law. Doctrine of frustration (Impossibility of Performance) **Breach-** Anticipatory breach and Actual breach. **Quasi Contract** (Section 68-72). **Remedies for Breach of Contracts** – Damages – Types of damages- Remoteness of damage, Quantum Merit.	30

TEXT BOOKS:

- Singh Avtar, Law of Contract, Eastern Book Co, 12th edition, New Delhi, (2017).
- R.K. Bangia, Law of Contract-II, Allahabad Law Agency, Prayagraj, (2019).
- S.S. Srivastava, Law of Contract-I & II, Central Law Publication, 5Th edition, New Delhi, (2015).
- Bare Act, The Indian Contract Act, 1872, Universal Law Publication, New Delhi, (2016).

REFERENCE BOOKS:

- Pollock & Mulla, Indian Contract Act", Lexis Nexis, (2013).
- Anson's, Law of Contract", Offord University Press, (2015).
- Stephen A. Smith/Atiya, Law of Contract, Oxford, University Press, (2016).
- Jill Poole, Contract Law, Sixth Edition, Oxford university press, (2003).

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Acquired the basic knowledge of contracts.
- CO2: Know the validity of contracts which would help them to defend their clients.
- CO3: Acquainted with modes of discharge of contract which help them to apply in practical cases.
- CO4: Gain the knowledge about the forum and the cases under which remedy for breach of contract will be available.

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

COs	**POs/PSOs**
CO1	PO4/PSO2
CO2	PO4/PSO1/PSO2
CO3	PO2/PSO2
CO4	PO3/PSO1/PSO2

BALC 1003: FAMILY LAWS - I

OBJECTIVE:

This course focuses on various aspects of family law including marriage, adoption and related rights and liabilities. Both Hindu Law and Muslim Law along with emerging issues are covered under the paper. The objective is not only to make students well verse with codified law but also to make them understand sensitive issues relating to marriage and child custody.

Credits: 06 **Trimester IV** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Introduction and origin of Marriage** - Sources of Hindu law: Ancient and Modern Sources, Schools of Hindu Law: Mitakshara and the Dayabhaga School. **Law of Marriage** - Hindu Marriage Act, 1955, Hindu marriage: Essential of a valid marriage, Void and Voidable Marriage, Matrimonial Remedies and Obligations: (Hindu Law) -Restitution of Conjugal Rights, Judicial Separation, Dissolution of Marriage under Hindu Law, **Dissolution of Marriage:** Theories, Forms of Divorce, Grounds, Divorce by Mutual Consent, Irretrievable Breakdown as a Ground for Dissolution. Adoption, **Maintenance and Guardianship:** Hindu Adoption and Maintenance Act, 1956 & Hindu Marriage Act, 1955, Adoption, Ceremonies, Capability, Effect, Inter country adoption, Maintenance, Entitlement, Enforcement. Hindu Minority and Guardianship Act, 1956, Meaning, Kinds of guardianship, Right, Obligations and disqualification of guardian	30
II	**Introduction-** Who is Muslim? Sources of Muslim Law, Ancient and Modern Sources Schools of Muslim Law. **Muslim marriage -** Nikah (Muslim Marriage) Definition, objects and nature, Essentials and validity. **Dower -** Definition, concept, kinds and nature of dower under Muslim Law. **Dissolution of Marriage under Muslim Law -** (Divorce) Talaq: Concept, Ila, Khula, Mubarrat, Talaq-e-Tafweed, Lian, Faskh and recent developments in Triple Tala and Modes of dissolution of Muslim-marriage. **Adoption, Maintenance and Guardianship Parentage and Legitimacy -** Maintenance under Muslim Women (Protection of Rights on Divorce) Act, 1986 and under the Code of Criminal Procedure, 1973**.**Classification of Guardians, Natural Guardians, Guardians appointed by Court and power and functions of Guardians under Muslim Law. Parentage and Legitimacy under Muslim law.	30

TEXT BOOKS:

- Diwan, Paras (2018), Family Law, Allahabad Law Agency, Allahabad.
- Gandhi, B. M. (2016), Family Law, Eastern Book Company, New Delhi.
- Diwan, Paras (2017), Muslim Law in Modern India, Allahabad Law Agency, Allahabad.

REFERENCE BOOKS:

- Kusum, (2015), Family Law Lectures – Family Law I, Allahabad Law Agency, Allahabad.
- Fyzee, A. A. A. (1974), Outlines of Mohammadan Law, Oxford University Press, New Delhi.
- Mulla, (1906), Principles of Mohammadan Law, Lexis Nexis Publication, London.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Create awareness of the family law in the society thereby the needed people may get justice by resolving their issue by filling petition in the court of law.
- CO2: Present logical legal arguments by exhibiting the ability to research and critically analyze and apply legal knowledge in legal problem solving and conflicting perspectives.
- CO3: Communicate effectively in oral and in writing, using language and legal terminology accurately and effectively in the legal profession.
- CO4: Apply legal knowledge to complex problem situations and offer potential solutions within a simulated professional context.

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

COs	**POs/PSOs**
CO1	PO4/PSO2
CO2	PO4/PSO2
CO3	PO2/PSO2
CO4	PO3/PSO1/PSO2

LAW OF CONTRACT – II

OBJECTIVE:

This course will discuss:

- The general principles of contract emphasis on understanding the basic essentials of a valid contract. In the present scenario, a law student should also acquaint himself with the knowledge of special contracts apart from equipping himself with general principles of contract.
- This course familiarizes students to better appreciate the legal services required in a corporate office so that he can enhance his relevance as a lawyer in the society.
- This course focuses on the special contracts and provides an insight of statutory provisions.

Credits: 06 **Trimester II** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	Contract of Indemnity and Guarantee (Sec. 124-147), Indemnity & Guarantee- the Concept, Definition, Nature and scope, Rights of Indemnity holder- Commencement of the Indemnifier's liability, Distinction between Indemnity and Guarantee, Rights/Duties of Indemnifier, Indemnified and Surety, Extent of Surety's liability- Co-surety, Discharge of Surety's liability, Kinds of Guarantee, Bailment and Pledge (Sec. 148-171 and Sec. 172-181), Contract of Bailment- Definition – kinds – Rights and Duties of Bailer and Bailee, Rights of Lien.	30
II	Contract of Pledge- Definition- comparison with Bailment, Rights and Duties of Pawnor and Pawnee, Termination of Bailment, Agency (Sec. 182 – 238), Definition of Agent and Principal, Essentials of relationship of Agency, Rights and Duties of Agent, Creation of Agency: by agreement, ratification and law, Relation of Principal/ agent, sub agent, substituted agent, Personal liability of agents, Termination of agency. **Specific Relief Act, 1963**: Nature of Specific Relief, Meaning of Specific Performance, Enforcement of Contract, Specific performance when granted and not granted, Preventive Relief- Temporary Injunctions- Perpetual and Mandatory Injunction.	30

TEXT BOOKS:

- Sings Avatar, Law of Contract, 12th edition Eastern Book Co, 2017
- R.K. Bangia, "Law of Contract-II", Allahabad Law Agency, 2019
- S.S. Srivastava, "Law of Contract-I & II", 5Th edition, Central Law Publication, 2015
- The Indian Contract Act, 1872. Bare Act by Universal Law Publication 2016

REFERENCE BOOKS:

- Pollock & Mulla, "The Indian Contract Act", Lexis Nexis, (2025).
- Anson's," Law of Contract" Oxford university press (2016).
- Stephen A. smith/Atiya, "Law of Contract", Oxford University Press (2006).
- Jill Poole." Contract Law", Oxford university press. (2003).

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Gain knowledge relating to contract of Indemnity which would help them to deal with cases of banks and consumers.

- CO2: Good knowledge relating to bailment and pledge which would help them to deal with cases of banks, companies, and consumers.
- CO3: Acquainted with law relating to agency, the rights and duties of agent and principal which would help them to deal cases of banks.
- CO4: Emphasize on the study of remedies provided in the law

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

COs	**POs/PSOs**
CO1	PO3/PO4/PSO4
CO2	PO4/PSO4
CO3	PO2/PSO4/PSO7
CO4	PO3/PSO1

FAMILY LAWS – II

OBJECTIVE:

The Main objective of this course is to deal with the succession under the Hindu, Muslim Laws. Matters relating to joint family system, role of Karta, laws relating to partition and religious endowments have been included in the course. Under Muslim Law, wills, Gifts and pre-emption have been included in separate modules along with Sunni and Shia Law of Inheritance. Modes and laws of Inheritance under Muslim law have been included for better understanding.

Credits: 06 **Trimester V** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Joint Hindu Family and Coparcenary:** Meaning, Characteristics & Distinction between Hindu Joint Family and Coparcenary, Distinction between Mitakshara & Dayabhaga Coparcenary, Rights of Coparceners and Position of Female Coparceners, Karta – Position, Powers and Rights & Duties. **Joint Family Property:** Ancestral, Doctrine of Accretion, Doctrine of Detriment, Doctrine of Blending. Separate or Self Acquired Property, Inherited Property under Hindu Succession Act, 1956 Alienation of Hindu Joint Family Property – Karta's & Coparcener's Power of Alienation. **Partition:** Meaning, Subject Matter, Modes, Revocation **Law of Succession:** General principles of succession under Hindu. **Wills:** Wills, Codicil sand Kinds of will Indian Succession Act, 1925.	30
II	**Law of Succession:** General principles of succession under Muslim, difference between Intestate Succession and Testamentary Succession, General Rules of Inheritance - Classification of Heirs under the Shia Law & Sunni Law **Gift (Hiba) and Wills (Wasiyat) under Muslim Law:** Meaning, Objects & Essentials of a Valid Gift and Revocation, Irregular Gifts under Shia, and Sunni Law. Definition, essentials and subject matter of Wills (Wasiyat). testamentary right: One Third Rule. Abatement of Legacies. Revocation of Wills. Reteable distribution under Sunni law and Preferential distribution under Shia Law. Death-bed Gifts. **Right of Pre-Emption (Shufa):** Definition, Essentials Elements and Nature of Pre-Emption. Existence of the Right and formalities: three Demands and legal effects of Pre-Emption.	30

TEXT BOOKS:

Diwan, Paras (2018), *Family Law*, Allahabad Law Agency, Allahabad.

- Gandhi, B. M. (2016), *Family Law*, Eastern Book Company, New Delhi.
- Diwan, Paras (2017), *Muslim Law in Modern India*, Allahabad Law Agency, Allahabad.

REFERENCE BOOKS:

- Kusum, (2015), *Family Law Lectures – Family Law I*, Allahabad Law Agency, Allahabad.
- Fyzee, A. A. A. (1974), *Outlines of Mohammadan Law*, Oxford University Press, New Delhi.
- Mulla, (1906), *Principles of Mohammadan Law*, Lexis Nexis Publication, London.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Comprehend and explain key legal concepts underpinning India's Succession Law system
- CO2: Critically evaluate the challenges and debates surrounding Succession Law
- CO3: Identify, analyze and critically assess disputes between parties involving issues of ancestral, self-acquired and separate property and succession and, Wills under Hindu and Muslim law
- CO4: Demonstrate legal problem-solving skills, which generate appropriate responses to complex statutory problems in the field of Family Law.

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

COs	**POs/PSOs**
CO1	PO1/PO2/PSO7
CO2	PO2/PO3/PSO6
CO3	PO1/PO2/PSO6
CO4	PO3/PSO2

INTERPRETATION OF STATUTES

OBJECTIVE

In terms of law it is not only necessary to enact the law but the proper implementation of the same as well. This can be insured only by ensuring the mechanism in which least ambiguities, inconsistencies, contradictions, or lacunas are found. This mechanism can be developed only through finding out the proper tools of interpretation of enacted, codified laws and customs. Study of law of interpretation is only ensuring that mechanism and parts of it.

Credits: 06 **TRIMESTER XI** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	Interpretation -Meaning, Definition, Object, Nature and Scope. General Rules of Interpretation. Meaning of the term Statutes- Title, Preamble, Heading and Marginal Notes, Punctuation marks, Illustration, Exceptions, Proviso and Saving clause, schedule, Non-obstante clause. Statute- Commencement and Repeal thereof, Procedure of Passing a Bill. The General Clause Act, 1897: Nature, Scope and relevance, definitions in various legislations.Parts of a Statute - Commencement, operation and repeal and revival of statutes, Purpose of Statutory Interpretation. Various rules of construction -Literal Rule of Interpretation, Golden Rule of Interpretation, Mischief Rule of Interpretation, Beneficial construction, Restrictive Construction Rule of Strict Rule of Interpretation, Harmonious Construction, and Interpretation of Taxing Statutes.	30
II	Interpretation of Constitution - Doctrine of Pith and Substance and Colorable Legislation. Preamble as a tool – Reading Directive Principles and Fundamental Duties with Fundamental Rights. Intrinsic and Extrinsic Aids to Interpretation - Dictionaries, pronunciation and legal abbreviations, Methods of studying law: and lectures, evaluation, Case law method: Explanation, Case Studies and evaluation, Using the library: Law reports, methods of using a law dictionary and of finding a reference: Examples and exercises. Maxim - Ejusdem Generis, Expressio Unius Exclusio Alterius and Pari Materia.	30

TEXT BOOKS:

- Vepa Sarathi - Interpretation of Statutes, Eastern Book Co. (EBC); 2015 edition (2015)
- G.P. Singh - Principles of Statutory Interpretation (Also Including General Clauses Act, 1897 With Notes), Lexis Nexis; First edition (25 May 2016)

REFERENCE BOOKS:

- Jeremy Bentham - Theories of Legislation, Lexis Nexis; Second edition (2010)
- Jeremy Bentham – An Introduction to the Principles of Morals and Legislation, Dover Publications Inc. (5 June 2007)
- William Fielden Craies and S.G.G. Edgar, Craies on Statute Law, Sweet & Maxwell; 7th Revised edition (1 December 1971)
- Maxwell - Interpretation of Statutes, Lexis Nexis; First edition (2010)

Focus: This course focuses on skill development aligned with all Cos

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Find out the true sense of an enactment by giving the words of the enactment their natural and ordinary meaning.
- CO2: Understand the process of statute making and the process of interpretation of statutes.
- CO3: Apply rules of interpretation while interpreting the statute.
- CO4: Understand the principles for interpretation of Constitutional document.

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

COs	**POs/PSOs**
CO1	PO3/PO4/PSO4
CO2	PO1/PSO2
CO3	PO2/PSO7
CO4	PO3/PSO6

MANAGERIAL ECONOMICS-I

OBJECTIVE:

The course content provides the students the knowledge, tools, and techniques to make effective economic decisions under conditions of risk and uncertainty

Credits: 05 **Semester VI** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
I	**Introduction to Managerial Economics:** Application of managerial economics, Micro Vs Macro Economics, Basic principles of Managerial Economics, Opportunity Cost Principle, Incremental Principle, Principle of time perspective, Discounting principle **Consumer Behavior, Demand And Supply Analysis:** Law of demand, Theory of demand, Shift in demand curves, Concept of measurement of elasticity of demand, Factors affecting elasticity of demand, Income elasticity of demand, Cross elasticity of demand, Cardinal utility approach, Diminishing marginal utility, Law of equi marginal utility, Ordinal utility approach, Indifference curve, Marginal rate of substitution, Budget line and consumer equilibrium, Law of supply, shift in supply curve.	24
II	**Macro Economics and some of its measures:** Introduction, Basic Concepts, Macroeconomic Ratios, Index Numbers, National Income Deflators. **Stabilization Policies**-Introduction, Economic Stability, Instruments of economic Stability, Monetary Policy, Fiscal Policy, Physical Policy or Direct Controls.	24

TEXT BOOKS:

- Ahuja, H.L (2017), *Advanced Economic Theory(Microeconomic Analysis)*, S. Chand Publication, New Delhi.
- Geethka Ghosh.P. and Roy Choudhary.P. (2015), *Managerial Economics,* Tata McGraw Hill Education, New Delhi.

REFERENCE BOOKS:

- Mehta , P.L.(2014), *Managerial Economics*, Sultan Chand and Sons Educational Publication, New Delhi.
- D.M. Mithani, (2013), *Managerial Economics*, Himalaya Publication, New delhi.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Gain the knowledge about tools, and techniques to make effective economic decisions under conditions of risk and uncertainty.
- CO2: Understand the consumer behavior and the demand and supply theory.
- CO3: Understand the law of demand, supply forecasting, consumer durable.
- CO4: Know law of diminishing proportion, product function, Economies of scale.

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

COs	POs/PSOs
CO1	PO4/PSO4

CO2	PO4/PSO4
CO3	PO2/PSO4
CO4	PO3/PSO1

LAWS OF TAXATION

OBJECTIVE:

This course introduces the study of law in the fold of taxation. The primary purpose of taxation is to raise revenue to meet huge public expenditure. Most governmental activities must be financed by taxation. But it is not the only goal. In other words, taxation policy has some non-revenue objectives.

Credits: 05 **Semester IX** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hour
I	Concept of Tax-Nature and characteristic of taxes-distinction between tax and fee, tax and cess-kind of taxes. Direct and indirect taxes-tax evasion and tax avoidance-mutual relationship between Income tax Act and Finance Act. Interpretation of tax laws. Preliminaries-concepts: Income, agricultural income, casual income, assessed person-Residential status-previous year, assessment year. Exempted Income-Agricultural income and its treatment.	24
II	Taxability under specific heads –Income from salaries, Income from house property, Income from business or profession, Income from capital gains, Income from other sources. Clubbing of income-Income of other personsin assessee total income .Set off and carry forward of loss. Authorities under the Act, Role of High court and Supreme court, Appeals, Review and Revision, Filling of returns Penalties and Prosecution ,Deduction allowed I certain cases, Chapter VIA deduction GOODS AND SERVICES TAX: Constitutional amendment for introduction of GST. Centre State Relations –GST Council- GST Network, Registration Filling of returns-Impact on import and exports	24

TEXT BOOKS:

- Ahuja, Girish and Dr.Ravi Gupta, (2018), *Professional Approach to Direct Taxes law and Practice including Tax Planning*, Zed Books Publications, New Delhi.
- Singhania V. K. (2009), *Direct Taxes-Law and Practice*, Taxmann Publications, New Delhi.
- Prasad, Bhagwati (2016), *Income Tax Law and Practice*, Wishva Prakashan, New Delhi.

REFERENCE BOOKS:

- Prasad, Bhagwati (2016), *Income Tax Law and Practice*, Wishva Prakashan, New Delhi.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Analyze the taxation law.
- CO2: Understand the concept of taxation.
- CO3: Learn about the different slabs.
- CO4: Equip the students with thoughts and points on assessment of firms

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

COs	**POs/PSOs**
CO1	PO4/PSO3
CO2	PO4/PSO3
CO3	PO2/PSO3
CO4	PO3/PSO3

CORPORATE ACCOUNTING-I

OBJECTIVE:
The purpose of this course to enable the students to develop awareness about corporate accounting in conformity with the provisions of Companies Act. Corporate accounting deals the concepts, principles and practices in Corporate Accounting and Indian and International Accounting Standards.

Credits: 05 **Semester III** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
I	**Introduction to Corporate Accounting:** Records of accounts to be maintained by a company. **Accounting for Share Capital:** Meaning and types of shares, Issue of Shares; Forfeiture and Re-issue of Shares, Procedure of issue of shares and pro-rata allotment of shares. Accounting treatment of premium, Buyback of Shares; Redemption and Conversion; Capital Redemption Reserve, Bonus Shares; Rights Issue, ESOPs, ESPS, Sweat Equity Shares; and Underwriting; Book Building. **Debentures:** Meaning and types of debentures, Issue and Sources of debentures, sources of redemption of debentures. Accounting Treatment, Debenture Redemption Reserve, Redemption of Debentures and Conversion of Debentures into Shares. Deferred Tax. **Redemption of Preference Shares:** Types of preference shares, sources of redemption of preference and accounting entries.	24
II	**Profit or Loss Prior to Incorporation**: Accounting treatment cut-off date, Basis of Apportionment. **Accounting for Tax:** Concept of deferred tax assets and deferred tax liability in line with Ind AS -12 (Income taxes), Underwriting of shares and debentures. **Internal Reconstruction**: Meaning, Objective, Procedure, form of reduction, accounting treatment, Preparation of Balance Sheet after Reconstruction. **Consolidation of Accounts as per Companies Act, 2013 :**Holding Company, Subsidiary Companies, Associate Companies and Joint Venture; Accounting Treatment and disclosures **Company Final Accounts**: Framework for preparation and presentation of Financial statement in accordance with Indian Companies Act 2013 and Indian Accounting Standard (Ind AS) with treatment of special items- Interest on debentures, Interest out of capital & dividends and Managerial Remuneration.	24

Text Books:

- Maheshwari S. N. (2017), *Corporate Accounting*, Vikas Publishing House, New Delhi.
- Gupta R.L. Radhaswamy M. (2017), *Company Accounts*, Sultan Chand and Sons, New Delhi.
- Monga, J. R. (2014), *Fudamentals of Corporate Accounting* Mayur Paper Backs, New Delhi.

Reference Books:

- Jain, S.P. and Narang, K. L. (2017), *Corporate Accounting*, Kalyani Publishers, New Delhi.
- Sehgal, A. and Sehgal, D. (2016), *Corporate Accounting*, Taxmann Publication, New Delhi.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Develop awareness about corporate accounting in conformity with the provisions of Companies Act.

- CO2: Understand the concepts, principles and practices in Corporate Accounting and Indian and International Accounting Standards.
- CO3: To give an exposure to the company final accounts.
- CO4: To provide knowledge on Goodwill.

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

COs	**POs/PSOs**
CO1	PO3/PSO4/PSO7
CO2	PO2/PO4/PSO2
CO3	PO1/PO2/PSO2
CO4	PO3/PSO2

CORPORATE ACCOUNTING-II

OBJECTIVE:

To provide students with an understanding of the presentation and understanding of financial reporting for partners and the external users, decision as a basic language of business.

Credits: 05 **Semester IV** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
I	**Cash Flow Statement:** Meaning, Objective, operating activities, investing activities and financing activities. Preparation of cash flow statement with direct method. Numerical Problems. **Fund Flow Statement:** Meaning Objective and Numerical problems on preparation of Fund flow statement.	24
II	**Ind AS 16 & 36: Plant ,Property and Equipment & Impairment of Assets :** Timing of recognizing an asset, Determining the carrying amounts of the assets, Depreciation to be recognized in the financial statements, Revaluation Model, Identification of Assets to be impaired, Calculation of Recoverable Amount, Recognizing and measuring the impairment loss, Reversal of Impairment loss. **Calculation of Earnings per share**: Basic EPS, Diluted EPS, Ind AS 33, Presentation, Disclosure. **Ind AS 103**: **Business Combinations:** Identification of Business Combination, Acquirer and Acquisition Date, Consideration transferred as part of BC, Identification of Assets and Liabilities Assumed, Goodwill / Bargain Purchase, Measurement after Initial Recognition• Disclosures	24

TEXT BOOKS:

- Maheshwari S. N. (2017), *Corporate Accounting*, Vikas Publishing House, New Delhi.
- Gupta R.L. Radhaswamy M. (2017), *Company Accounts*, Sultan Chand and Sons, New Delhi.
- Monga, J. R. (2014), *Fudamentals of Corporate Accounting* Mayur Paper Backs, New Delhi.

REFERENCE BOOKS

- Jain, S.P. and Narang, K. L. (2017), *Corporate Accounting*, Kalyani Publishers, New Delhi.
- Sehgal, A. and Sehgal, D. (2016), *Corporate Accounting*, Taxmann Publication, New Delhi.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: Understand the presentation and understand the financial reporting for partners and the external users.
- CO2: Enabling the students to understand the features of Shares and Debentures
- CO3: Develop an understanding about redemption of Shares and Debenture and its types
- CO4: Learn the decision-making power as a basic language of business.

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

COs	**POs/PSOs**
CO1	PO4/PSO4
CO2	PO4/PSO4
CO3	PO2/PSO4
CO4	PO3/PSO1

MANAGERIAL ECONOMICS-II

OBJECTIVE:

This course introduces the relationship of law and Managerial economic. Managerial economics is a bridge between economics and business management. It aims to offer optimum solutions to business problems. In short managerial economics shows how to apply economic concepts and theories to business decision making and planning with the help of real world examples and case studies. Student of Law will be benefited from this course.

Credits: 05 **Semester V** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hour
I	**Concepts and Techniques:** Nature and scope of managerial economics, application of managerial economics in decision making, managerial analysis, meaning and function of demand, definition of demand, demand of forecasting, demand forecasting techniques Managerial economists role and responsibility **Production Function:** Types of production function-one variable and two variables, Law of return and return scales.	24
II	Market analysis: Definition, market structure, perfect competition. Price and output decision under different market structures, price discrimination, no price discrimination, monopoly, monopolystic competition, Oligopoly and Duopoly, price determination under perfect and monopolystic market. National Income-measurement of national income, Business cycle Inflation-Causes and control, Stagflation, Fiscal deficit Fiscal responsibility inb India-FRBM Act., Monetary policy of the RBI-CRS,SLR,Reporates,Government and Business: Capital Markets and Market Regulator SEBI Economics of International Trade Relations:BOP,BOT,Fair Trade Practices, Foreign Currency Exchange Rates Mechanism Finance commission-Its objective and roles, New economicpolocy-1991-Liberalization Privatization, Globalisation.	24

TEXT BOOKS:

- Ahuja, H.L (2017), *Advanced Economic Theory(Microeconomic Analysis)*, S. Chand Publication, New Delhi.
- Geethka Ghosh.P. and Roy Choudhary.P. (2015), *Managerial Economics,* Tata McGraw Hill Education, New Delhi.

REFERENCE BOOKS:

- Mehta , P.L.(2014), *Managerial Economics*, Sultan Chand and Sons Educational Publication, New Delhi.
- D.M. Mithani, (2013), *Managerial Economics,* Himalaya Publication, New delhi.

Focus: This course focuses on skill development aligned with all Cos

Course Outcomes: At the end of the course, students will be able to:

- CO1: To understand the basic elements of managerial economics aspects, nature and decision making.
- CO2: Offer optimum solutions to business problems.
- CO3: Apply economic concepts and theories to business decision making and planning with the help of real-world examples and case studies.
- CO4: To understand Pricing policy under Perfect Competition Monopoly

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

COs	**POs/PSOs**
CO1	PO4/PSO1
CO2	PO4/PSO1
CO3	PO2/PSO1
CO4	PO3/PSO1

LABOUR LAW- I

OBJECTIVE:

The objectives of studying this course are-

- To study relevant Constitutional provisions to ensure labour protection, protection of basic rights of labour, effective implementation of labour laws
- To categorize the different classes of labour in India.
- To understand the different dimensions of socio-economic problems faced by the labors in India and other countries.
- To understand the judicial role in upholding and ignoring the Labour Jurisprudence in changing socio-economic conditions
- To make the students aware of the new forms of exploitation of the labours in the era of Globalization Privatization and Liberalization.

Credits: 06 **Trimester VII** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	Brief history of Trade Union movement in Britain in India and the enactment of the Indian Trade Union Act. Provisions contained in the Trade Union Act. The interplay of provisions in this Act and the other Acts. The Trade Union Act and the related Constitutional provisions in the light of ILO Conventions and Recommendations. Trade Union immunities and their relevance in the present-day context. Recognition of Trade Unions - need and the efforts made in this direction - Methods for identifying the strength of Trade Unions. Minors as employees and their rights relating to Trade Union. Collective bargaining. The legislative framework for collective bargaining, weapons of collective bargaining - Status of collective bargaining settlements - collective bargaining in the context of liberalization.	30
II	**Industrial Dispute Act:** Development of Industrial Disputes Legislation in India, Object and applicability of the Act **,** Definition of Industry, Industrial Dispute, Workmen and 'Public Utility Service', Authorities under Industrial Dispute Act, 1947, Duties and jurisdiction of adjudicating authorities**,** Procedure and power of authorities, Voluntary reference of disputes to Arbitration, Lay-off, Retrenchment, and Closure, Strike and lockout, Unfair Labour Practices, Disciplinary Action and Domestic Enquiry, Management's Prerogative during the Pendency of Proceedings, Notice of Change. **The Industrial Employment (Standing Orders) Act, 1946:** Concept and Nature of Standing Orders, Scope and Coverage of the Industrial Employment (Standing Orders) Act, 1946, Certification Process, Modification and Temporary Application of Model Standing Orders, Interpretation and Enforcement of Standing Orders, Penalties and Procedure.	30

LEARNING OUTCOME:

1. The student will be able to understand the importance and relevance of Industrial Jurisprudence emphasizing on Social Justice.

2. The student will understand the evolution of labour legislation in India with specific reference to state.

3. The student will be able critically analyze the important labour and industrial legislations and their relevance in Indian context.

4. The student will be familiar with the latest development in the field of labour and industrial laws.
5. The student will be able to apply the relevant laws to actual cases/situations.

Focus: apply the relevant laws to actual cases/situations

TEXT BOOKS:

- Kaufman B. K. (2006). *The Global Evolution of Industrial Relations: Events, Ideas AND The IIRA*. Academic Foundation.
- Rao E. M. (2015). *Industrial Jurisprudence –A Critical Commentary*. New- Delhi: Lexis Nexis
- Pillai K. M. (2015). *Labour and Industrial Law*. Allahabad: Allahabad Law Agency.
- Malhotra O. P. (2015). *The Law of Industrial Disputes.* New Delhi: Lexis Nexis.
- Srivastava S. C. (2007). Industrial Relations and Labour Laws. New Delhi: Vikas Publishing House.
- Mishra S. N. (2016). *Labour and Industrial Laws*. Allahabad: Central Law Publications

REFERENCE BOOKS:

- M.S Siddiqui, Cases and Materials on Labour Law and Labour Relation, Indian Law
- Institute, 1963
- P.L. Malik, Industrial Law, Eastern Book Company, 2013
- Dr. Goswami, Labour and Industrial Law, Central Law Agency, 2011
- Chaturvedi, Labour and Industrial Law, 2004
- ZMS Siddiqi and M.Afzal Wani, Labour Adjudication in India, ILI, 2001.

LAW OF CRIMES – I

OBJECTIVE:

The purpose of the Paper is to enable the students to understand the general principles of criminal liability, to identify the ingredients of an offence, understand the range of state of mind required for different offences. The primary objectives of this course are: - To acquaint the students with the key concepts of crime and criminal law, To expose the students to the range of mental states that constitute mens rea essential for committing a crime, To teach specific offences under the Indian Penal Code, To keep students abreast of the latest developments and changes in the field of criminal.

Credits: 6 **Trimester VII** **L–T–P: 4– 2–2**

Module No.	Content	Teaching Hours
I	**Extent and operation of the Indian PenalCode:** Definition ofCrime, **Constituents Elements of Crime**: *Actus Reus* and *Mensrea* . **General Exceptions:**(Sections76-106)-Mistake, Judicial and Executive act, Accident, Necessity, Infancy, Insanity, Intoxication, Consent, Good Faith Private defense against Body and Property. Joint and Constructive Liability Criminal (Sections 49 &149)	30
II	**Inchoate crimes:** Conspiracy, Attempt, Abetment. (sections 107,120A,120B &511) Offences against theState.(sections 121,124A) Offence against PublicTranquility.(sections 141,146&159.) Theories of Punishment with special reference to CapitalPunishment. .	30

LEARNING OUTCOME:

The students will be able to understand the general principles of criminal law, key concepts, its application and recent developments in the field.

Focus: criminal and its application

TEXT BOOKS:

- K.T. Thomas, M.A. Rashid (Rev.), **Ratan Lal & Dhiraj Lal's *The Indian Penal Code***, (34th ed., 2014)
- K.D. Gaur, Criminal Law: ***Cases and Materials***, (8th ed., 2015)
- R.C. Nigam, ***Law of Crimes in India*** (Vol. I) (1965)
- V.B. Raju, ***Commentary on Indian Penal Code***, 1860 (Vol. I & II) (4th ed., 1982)
- K.N.C. Pillai &ShabistanAquil (Rev.), ***Essays on the Indian Penal Code*** (The Indian Law Institute, 2005) 6) K. I. Vibhute (Rev.), P.S.A. Pillai's ***Criminal Law*** (12th ed., 2014)
- Syed Shamsul Huda, ***The Principles of the Law of Crimes in British India*** (1902)

K.N. Chandrasekharan Pillai, ***General Principles of Criminal Law***(2nd ed., 2011

PROPERTY LAW AND EASEMENT LAW

OBJECTIVES:

The objectives of studying this course are-

- To equipping students with the concept of property
- To explain various provisions of the Transfer of Property Act, 1882 and Easement Act, 1882
- To demonstrate the operation for transfer of immovable property.
- To outline the substantive law relating to particular transfers, such as sale, mortgage, lease, exchange, gift and actionable claims.
- To build the strong command on underlying of easements and licences, the rights of parties, etc.

Credits: 6 **Trimester VII** **L–T–P: 4– 2–2**

Module No.	Content	Teaching Hours
Module-I	**Concept of Property and General Principles Relating to Transfer of Property:** Concept of property: distinction between moveable and immoveable property**,** Definition clause: Immovable property, Attestation, Notice, Actionable claim**,** Definition to transfer of property (Sec.5)**,** Transfer and non-transfer property (Sec.10-12)**,** Transfer to an unborn child and rule against perpetuity (Sec.13, 14, 17)**,** Vested and Contingent interest (Sec.19 & 21)**,** Rule of Election (Sec.35)	30
Module-II	**General Principles Governing Transfer of Immoveable Property:** Transfer by ostensible owner**,** Rule of feeding the grant by estoppels**,** Rule of Lis pendens**,** Fraudulent transfer**,** Rule of part performance e**,** Vested and contingent interest**,** Conditional transfer **Specific Transfers and Easement Act:** Sale and gift**,** Mortgage and charge**,** Lease and License**,** Object and main provisions of the Easement Act**,** Creation of Easement**,** Riparian rights, introduction of Equity and Trust Law.	30

LEARNING OUTCOMES:

- Students would be able to understand clear, systematic and uniform law for transfer of immovable property.
- Students would be able to understand various provisions *inter- vivos.*
- Students would be able to apply principles of justice, equity and good consciences, if a particular case is not governed by any provision of law.
- Students would be able to know various modes of transfer of property and easements rights.

Focus: To know various modes of transfer of property and easements

REFERENCE BOOKS:

- Mulla, Transfer of Property Act, 1999, Universal Delhi

- Subba Rao, Transfer of Property Act, 1994, Subbiah Chetty, Madras
- V.P.Sarathy, Transfer of Property, 1995 Eastern Book Co.
- T.P.Tripathi, Transfer of Property Act, 2007
- S.N.Shukla, Transfer of Property Act, 2007

STATUTORY MATERIALS:

- The Transfer of Property Act, 1882
- The Indian Easement Act, 1882

ADMINISTRATIVE LAW

OBJECTIVE:

The paper will make the students aware of various aspects of Administrative Law including quasi legislative ,quasi-judicial and other ministerial functions of administration and control thereof with a practical approach.

Credits: 06 **Trimester VIII** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Evolution and Scope ofAdministrative Law: -** Nature, Scope and Development of Administrative Law ,Rule of Law and AdministrativeLaw ,Separation of Powers and itsRelevanceRelationship between Constitutional Law and AdministrativeLaw ,Classification of AdministrativeLaw **Meaning and Concept of DelegatedLegislation: -**Constitutionality of DelegatedLegislation**, Control**Mechanism**:** Parliamentary Control of Delegated Legislation**,** Judicial Control of Delegated Legislation**,** Procedural control of DelegatedLegislation, Sub-Delegation **Judicial Function of Administration: -** Need for adjudicatory authority on administration, Problem of Administrative Decision Making, Nature of Administrative Tribunals: Constitution, Powers, Procedures, Rules of Evidence Principles of Natural Justice: - 1 Rules against bias 2-Audi Alteram Partem 3- Speaking Order	30
II	**Administrative Discretion and Judicial Control of Administrative Action**: -Need and its Relationship with Rule ofLaw, Judicial Review of Administrative Action and Grounds of Judicial Review: Abuse ofDiscretion, Failure to ExerciseDiscretion, Illegality, Irrationality, ProcedureImpropriety Doctrine of LegitimateExpectations, Evolution of Concept of*Ombudsmen*, *Lokpal*and *Lokayukta*Act and other Anti-corruption Bodies and their AdministrativeProcedures	30

LEARNING OUTCOME:

The students will be able to adopt a pragmatic approach in studying Public law, will be familiarize with the relationship between law and society, to understand basic ideas and fundamental principles Natural Justice. The application of Constitutional law and its application Students will be able to face exigencies of life.

Focus: emphasis on pragmatic approach in studying Public law

TEXT BOOKS:

- H.W.R. Wade & C.F. Forsyth, *Administrative Law*, Oxford University Press, 2009 (12thEdn)
- M.P. Jain & S.N. Jain, *Principles of Administrative Law*, Lexis Nexis, 2013 (7thEdn)
- Stanley De Smith & Rodney Brazier, *Constitutional and Administrative Law*, Penguin, 2000

REFERENCES:

- I.P. Massey, *Administrative Law*, Eastern Book Company, 2012,(8th
- C.K. Takwani, *Lectures on Administrative Law*, Eastern Book Company, 2012 (5thEdn)
- S.P. Sathe, *Administrative Law*, Lexis Nexis Butterworths Wadhwa, 2010 (7thEdn)

LABOUR LAW- II

OBJECTIVE:

The objectives of studying this course are to study the paper which will focus on wages, wage policies, compensation, social security and retirement benefits during the course of employment and working conditions of employees.

Credits: 06 **Trimester VIIIL–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Wages including minimum wages:** Definition of wages as given in the Industrial Disputes Act; Components of wages -Basic wages, Dearness Allowance and other allowances, indirect remuneration. Consumer price index, neutralization of price raise, etc. Different types of wages like minimum wages, fair wage and living wage. How these categories of wages will be determined. Minimum Wages Act will be dealt elaborately keeping in mind the judicial developments in this area and the ground realities. This module will also address issues like financial capacity of the employer; Industry-cum-region formula while fixing wages; equal pay for equal work - Equal Remuneration Act, 1976; Constitutional dimension of equal pay for equal work; Authorised deductions and procedure for the same as envisaged under the Payment of Wages Act. Implications of Wage Code,2019. **Bonus:** Brief history as to the payment of bonus; The contribution of Labour Appellate Tribunal and the judiciary in this regard; Payment of Bonus Act 1965 will be dealt in detail. Minimum Bonus and Maximum Bonus; Concepts of Available surplus and Allocable surplus; Whether bonus is deferred wages when the Statue prescribes minimum bonus to be paid irrespective of losses incurred by the employer. Customary Bonus; Exemptions for Start Up's **Employment injury compensation and liability of the employer to pay compensation:** Prevention of employment injury - relevant provisions of Factories Act ; Tort Law Liability in case of employment injury ; Fatal Accidents Act ; Employees' Compensation Act ; Employees State Insurance Act ; Classification of injuries; Disablement, Permanent total disablement; Permanent partial Disablement, Temporary disablement, Temporary total disablement, Temporary partial disablement, Occupational Diseases; Injury arising out of and in the course of employment, Physical injury and Psychological injury; Notional extension of time and place of the premises of employment; Doctrine of Added Peril; Non liability of Employers under the statutory framework; Computation of compensation under the Employees Compensation Act; Indemnification; How there is scope for improving upon these Statutory minimum standards. Rate of contribution under ESI Act; Benefits under ESI Act and the improvements made from Employees Compensation Act; Computation of benefits under ESI Act; Bar against receiving or recovery of compensation or damages under any other law;Need for taking insurance where ESI Act is not applicable. Medical insurance for employees.	30

II	**Retirement benefits:** This area of social security will address the legislations like Employees Provident fund – Contributory Provident Fund, 1925 Act as well as 1952 Act;Schemes envisaged under the Act, Concept of International Worker; Social Security Agreements; Provision for pension integrated to the contributory provident fund. Payment of Gratuity Act, 1972,Eligibility parameters; Formula for computing Gratuity; Employee Share option schemes and how they are working **Women and Welfare**: Social Security and Labour Welfare Provisions relating to women workers. Maternity Benefit Act, Shops and Commercial Establishments Act, 1962 etc.; The amendments brought out to Maternity benefits in 2017;The improvements made thereon from the Maternity Benefit Act; Special Provisions under the ESI Act; Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013;The History behind the legislation; Vishaka Guidelines; The constitution of Committees; The procedure for filing the complaint; The punishments meted out ; Appeal provisions; Scope for departmental proceedings and criminal proceeding to go on simultaneously. **Miscellaneous Legislations:** Factories Act, 1948; Definition of Occupier and Manufacturing process; Health,safety and welfare aspects of factory workers; The amendments brought in in the wake of Bhopal Gas Leak disaster in the Factories Act. Shops and Commercial Establishments Act, 1962;The definition of commercial establishment; Work hours; Progressive State Amendments regarding the same; Unorganized Workers Social Security Act, 2008; Definition of unorganized worker-How inclusive it is; The salient features; Schemes envisaged for unorganized workers; Building and Other Construction Workers (Regulation of Employment and Conditions Of Service) Act, 1996 and the related Welfare Cess Act.	30

LEARNING OUTCOME:

1. The student will be able to understand the provisions of renumeration and right of minimum wages.

2. The student will understand the importance of social legislations which are benefitting the employees in the form of funds or insurance.

3. The student will be able to critically analyze the minimum facility requirements for a factory.

4. The student will be able to understand his social obligation to protect the weaker sections of the society.

Focus: it will understand the importance of social legislations

TEXT BOOKS: (Latest Editions)

- Pillai K. M. (2015). *Labour and Industrial Law*. Allahabad: Allahabad Law Agency.
- Mishra S. N. (2016). *Labour and Industrial Laws*. Allahabad: Central Law Publications
- Goswami V. G. *Labour and Industrial Laws*.Allahabad: Central Law Agency.
- Khan & Khan*Labour Law*. Hyderabad: Asia Law house.
- Srivastava K. D.*Payment of Bonus Act*. Lucknow: Eastern Book Company.
- Srivastava K. D. *Payment of Wages Act*. Lucknow: Eastern Book Company.

- Srivastava S. C. *Treatise on Social Security*. New Delhi: Vikas Publishing House.

REFERENCE BOOKS:

- M.S Siddiqui, Cases and Materials on Labour Law and Labour Relation, Indian Law
- Institute, 1963
- ZMS Siddiqi and M.AfzalWani, Labour Adjudication in India, ILI, 2001
- Kumar, H L. (2008) *Labour laws: Everybody should know*.New Delhi: Universal Law Publishing Co.Pvt.Ltd
- Kumar, H L. *Checklist obligation of employers under labour laws*. Delhi: Universal Law Publishing Co.Pvt.Ltd

LAW OF CRIMES-II (INDIAN PENAL CODE)

OBJECTIVE:

The purpose of the subject is to enable the students to understand the general principles of criminal liability, to identify the ingredients of an offence, understand the range of state of mind required for different offences. The primary objectives of this course are: - To acquaint the students with the key concepts of crime and criminal law, To expose the students to the range of mental states that constitute mens rea essential for committing acrime, To teach specific offences under the Indian Penal Code, To keep students abreast of the latest developments and changes in the field of criminal.

Credits: 06 **Trimester VIII** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
Module-I	**Offences against the HumanBody: -**Culpable Homicide andMurder,Rash and Negligentact,DowryDeath,Attempt toMurderAttempt and Abetment toSuicide. Hurt and GrievousHurtCriminal Force and AssaultWrongful Restraint and WrongfulConfinementKidnapping andAbductions	**30**
Module-II	**Offences relating toMarriage:-**; Bigamy ,Adultery, Cruelty. **Offences relating to Property**: - Theft, Extortion, Robbery andDacoityCriminal Misappropriation and Criminal Breach of Trust Cheating andForgeryMischief. **Offences against Women** :-Outraging the Modesty of Women, *Voyeurism*, Stalking, AcidAttack Rape and UnnaturalOffence	**30**

LEARNING OUTCOME:

The students will be able to understand the general principles of criminal law, key concepts, its application, offences against women and recent developments in the field of criminal law.

Focus: understand the general principles of criminal law

REFERENCE BOOKS:

- K.T. Thomas, M.A. Rashid (Rev.), **Ratan Lal & Dhiraj Lal's *The Indian Penal Code***, (34th ed., 2014)
- K.D. Gaur, Criminal Law: ***Cases and Materials***, (8th ed., 2015)
- R.C. Nigam, ***Law of Crimes in India*** (Vol. I) (1965)
- V.B. Raju, ***Commentary on Indian Penal Code***, 1860 (Vol. I & II) (4th ed., 1982)
- K.N.C. Pillai & Shabistan Aquil (Rev.), ***Essays on the Indian Penal Code*** (The Indian Law Institute, 2005) 6) K. I. Vibhute (Rev.), P.S.A. Pillai's ***Criminal Law*** (12th ed., 2014)
- Syed Shamsul Huda, ***The Principles of the Law of Crimes in British India*** (1902)
- **K.N. Chandrasekharan Pillai**, ***General Principles of Criminal Law***(2nd ed., 2011)

BALC 4006: CIVIL PROCEDURE CODE I

OBJECTIVE:

Study of procedural law is important for a Law student. This course is designed to acquaint the students with the various stages through which a civil case passes through, and the connected matters.

Credits: 06 **Trimester IX** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	**Civil Procedure Code Introduction;** Distinction between procedural law and substantive law- History of the code, extent and its application, **definition:**-Judgment, Decree, preliminary and final Decree, orders, Means profit and Foreign Judgment. **Suits:** Jurisdiction of the civil courts- Kinds of jurisdiction-Bar on suits- Suits of civil nature (Sec.9); Doctrine of Res sub judice and Res judicata (Sec. 10, 11 and 12);Foreign Judgment (Sec. 13, 14);Place of Suits (Ss. 15 to 20); Transfer of Cases (Ss. 22 to 25).**Institution of suits and summons:** (Sec. 26, 0.4 and Sec. 27, 28, 31 and O.5); Interest and Costs (Sec. 34, 35, 35A, B); Pleading: Fundamental rules of pleadings- Plaint and Written Statement- Return and rejection of plaint- Defenses- Set off- Counter claim; Parties to the suit (O. 1): Joinder, misjoinder and non-joinder of parties- Misjoinder of causes of action- Multifariousness.	30
II	**Appearance and examination of parties** (O.9, O.18) – Discovery, inspection and production of documents (O.11 & O.13) – First hearing and framing of issues (O.10 and O.14) – Admission and affidavit (O.12 and O.19) – Adjournment (O.17) – Death, marriage-Insolvency of the parties (O.22) – Withdrawal and compromise of suits (O.23) – Judgment and Decree (O.20); Execution (Sec. 30 to 74, O.21): General principal of execution- Power of executing court- Transfer of decrees for execution- Mode of execution- a) Arrest and detention, b) Attachment, c) Sale.	30

Focus: various stages through which a civil case

TEXT BOOKS:

- DinshawFardauziMulla, *Mulla's Code of Civil Procedure*, Lexis Nixis (18th Edn)
- Sudipto Sarkar & V.R. Manohar, *Sarkar's Code of Civil Procedure* (2 Vols), LexisNexis India (11th Edn)
- C.K. Takwani, *Code of Civil Procedure*, Eastern Book Company, Reprinted 2015
- M.R. Malik, *Ganguly's Civil Court, Practice and Procedure*, Eastern Law House, 2012
- *Universal's Code of Civil Procedure, 1908* (Bare Act)
- M.P. Tandon, *Code of Civil Procedure*, Allahabad Law Agency, 2005

REFERENCE BOOKS:

Ganguly – Civil Court, Practice and Procedure

M.P. Tandon – Code of Civil Procedure.

LEARNING OUTCOMES:

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

CO1: comprehend and explain key legal concepts underpinning civil law;
CO2: critically evaluate the challenges and debates surrounding Civil law;

CO3: identify, analyze and critically assess disputes between parties involving issues of civil dispute;
CO4: demonstrate legal problem-solving skills, which generate appropriate responses to complex statutory problems in the field of Civil Law;

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 4007: COMPANY LAW

OBJECTIVE:

The course is designed to understand the formation, management and other activity of the companies. In view of the changing facts of global governance corporate governance plays a vital role in the development of an economy both national and international level. The companies Act 1956 has not been repealed but certain provisions replaced by the new Act of 2013. The notified sections which replace the provisions of Companies Act 1956 will be highlighted. Accordingly, the paper aims to introduce to the students the nuance of corporate law and the obligations of it towards society in discharging its trade relations and to be a good corporate citizen. Therefore, the paper needs to be taught in light of the new companies Amendment Act 2013.

Credits: 06 **Trimester IX** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	Meaning of Company, Distinction between company and other associations, Nature and kinds of company, Formation, promotion and incorporation of companies, Promoters: Position, duties and liabilities, Mode and consequences of incorporation, Uses and abuses of the corporate firm, lifting of corporate veil, Theory of Corporate personality, Memorandum of Association: Meaning, purpose and contents, alteration and binding nature of memorandum of association, Doctrine of ultra vires, Articles of Association: Meanings, form and contents, binding nature, alteration, relation with memorandum of Association, Doctrine of Constructive Notice of Memorandum and Articles, Doctrine of Indoor Management and its exceptions. **Shares:** meaning and kinds of shares, allotment of shares, general principles regarding allotment, statutory restrictions on allotment, Statutory share certificate, its objects and effects, **Transfer of shares**: Procedure for transfer of shares and restrictions on transfer of shares, certification of transfer relationship between transferor and transferee, Share Capital, reduction of share capital	30
II	Directors: Kinds, Powers and Duties, Legal position of directors, Liabilities of directors, Role of nominee Directors ,Managing Director and other managerial personnel. Meeting, Kinds and Procedure The balance of powers within companies	30

	Majority control and minority protection, Prevention of Oppression and Mismanagement. **Winding up of Companies** Kinds, Consequences and reasons of winding up of companies, Insolvency and Bankruptcy Code, Role of the Court in winding up of company Liability of past members Payment of liabilities Reconstruction and amalgamation Emerging trends in corporate social responsibility, legal liability of company-civil, criminal, tortuous and environmental	

TEXT BOOKS:

- Avtar Singh, (2018), Indian Company Law, Eastern Book Co, New Delhi.
- R.K. Bangia, (2018), Company Law, Allahabad Law Agency, Prayagraj.
- L.C.B. Gower, (2016), Principles of Modern Company Law, 1997 Sweet & Maxwell, London.
- Companies Act, 2013, Universal Law Publication, New Delhi.

REFERENCE BOOKS:

- A. Ramaiya, (2016), Guide to the Companies Act, Lexis Nexis, New Delhi.
- Palmer, Palmer's Company Law, 1987 Stevens, London.
- Gulshan, S.S., & Kapoor, (2018), G.K. Business Law including Company Law, New Age International Pvt. Ltd, New Delhi.
- Gogna, P.P., (2016), A Textbook of Company Law, Sultan Chand, New Delhi.

LEARNING OUTCOMES:

By the end of this course it is expected that the student will be able to:

CO1: Explain and apply to various fact scenarios the concept of separate legal entity.

CO2: To explain the basic documents such as MOA and AOA required for company.

CO3: To develop the ability to identify and effectively use the corporate law resources, to develop the ability to learn company law both independently and cooperatively in a professional environment.

CO4: To evaluate and analyze socially reasonable corporate behavior.

Focus: it analyze socially reasonable corporate behavior

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BALC 4006: THE CODE OF CRIMINAL PROCEDURE -I

OBJECTIVE:

The criminal procedure code is designed to look after the process of the administration and enforcement of criminal law. Without the criminal procedure code the substantive criminal law will become worthless. The course is designed to make the students understand how the Criminal procedure code controls and regulates the working of the machinery set up for the investigation and trial of offences.

Credits: 06 **TRIMESTER-IX** **L–T–P: 4–2–2**

Module No.	Content	Teaching Hours
I	**Introduction**: -(a)Object and Importance of Cr.P.C, **(b)**Functionaries under the Cr.P.C, **(c)Basic Concepts**: Bailable Offence, Non-Bailable Offence, Cognizable Offence, Non-cognizable Offence, Complaint, Charge, Police Report, Investigation, Inquiry and Trial, Summons Case, Warrant Case. **Arrest ,Bail and Pre-Trial Proceedings(a)** Arrest and Rights of an Arrested Person(b)Provision for Bail under the Code**(c)**Process to Compel Appearance of Person**(d)**Process to Compel Production of Things**(e)**Condition Requisites for Initiation of Proceeding**(f)**Complaint to Magistrate **(g)**Commencement of Proceeding before Magistrate.	30
II	**Trial Proceedings**: - (a)Framing of Charges and Joiner of Charge Jurisdiction of the Criminal Courts in Inquiries and Trials **.Types of trials:** Sessions Trial, Warrant Trial, Summons Trial, Summary Trial. **Judgment and Sentences** under the Code, Submission of Death Sentences for Confirmation. General Provisions as to Inquiries and Trial Execution, Suspension, Remission and Commutation of Sentences	30

TEXT BOOKS

- Ratanlal & Dhirajlal, *Criminal Procedure*,Lexis Nexis Butterworths Wadhwa, Nagpur,2012
- S.C. Sarkar, *The Law of Criminal Procedure*, Wadhawa &Co. , Nagpur,2007

REFERENCES:

- K.N. Chandrasekharan Pillai, *R.V. Kelkar's Lectures on Criminal Procedure,* Eastern Book Company,2013
- K.N. Chandrasekharan Pillai, *Criminal Procedure*, Eastern Book Company,2004
- Aiyer, Mitter, *Law of Bails- Practice and Procedure*, Law Publishers(India) Pvt. Ltd., 2012
- P.V. Ramakrishna, *Law of Bail, Bonds, Arrest and Custody*, Lexis Nexis,2008
- P.K. Majumdar, *Law of Bails, Bonds and Arrest*, Orient Publication,2012
- Justice P.S. Narayana, *Code of Criminal Procedure*, ALT Publications,2012
- *Bare Act of Code of Criminal Procedure,1973*

LEARNING OUTCOME:

CO1: The students will be able to appreciate the importance of criminal procedure and its applications in criminal justice system.

CO2: Students will be familiar with the Power, functions, and indispensable attributes in a civilized society, will be acquainted with stages of investigation and trail procedure thereof.

Focus: applications in criminal justice system

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2

BALC 4008: LAW OF TAXATION

OBJECTIVE:

To familiarize and update the students with the basic principles of Taxation, Structure of Indian Taxation system and provisions of direct tax.

Credits: 06 **Trimester IX** **L–T–P: 4-2–2**

Module No.	Content	Teaching Hours
I	**Basic Concept**: Income, Agricultural Income, Causal Income, Assessment Year, Previous Years, Gross Total Income, Total Income; Tax Evasion, Tax Avoidance, Tax Planning **Basis of Change**: -Scope of Total Income; Residence and Tax Liability Income which does not fall part of total income. **Heads of Income**: -Salaries; Income from property; Profits or gains of business or profession, including provisions relating to specific business; Capital gains and income from otherSources. **Constitutional Provisions** and Fiscal Relation between Centre and States.	30
II	**Computation of Tax Liability: -**Computation of total income and tax liability of an individual, H.U.F., and firm; Aggregation of Income; Set off and carry forward of losses Sale. **Tax Management**: - Tax deduction at source; Advance payment of tax; Assessment Procedures; Tax planning for Individuals. **Tax Administration**: - Authorities; Appeals; Penalties **Indirect Tax Regime**:-IGST-Integrated GST(IGST) levied by the Central Government. Inter-state transactions and imported goods or service state gst (SGST), Impact of GST on state revenue, Indemnifying state revenue loss.	30

TEXT BOOKS:

- Singhanar V.K: Students' Guide to Income Fax; Taxmann, Delhi.
- Prasaci, Bhagwati: Income Tax Law & Practice: Wiley Publication, New Delhi,
- Mehrotra H.C: Income Tax Law & Accounts; Sahitya Bhawan, Agra.
- Dinker Pagare, Income Tax Law and Practice: Sultan Chand & Sons, New Delhi.
- Girish Ahuja and Ravi Gupta: Systematic approach to income tax: Sahitya Bhawan Publications, New Delhi.
- Chandra Mahesh and Shukla D.C.: Income Tax Law and Practice; Pragati Publications, New
- V.S. Datey, GST Ready Reckoner, Taxmann Publications (P.) Ltd., New Delhi, 6th Edition (2018)
- V.S. Datey, All About GST, a Complete Guide to New Model GST Law, Taxmann Publications (P.) Ltd., New Delhi, 5th Edition

Pathik Shah, Hand book on Good and Service Tax, Bharati& Co., 1st edition (2017); 4. Rajat Mohan, Guide to GST, Bharat Law House Pvt. Ltd., New Delhi, 2016; 5. GST Laws Manual: Acts, Rules and Forms.

LEARNING OUTCOMES:

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

CO1: Describe how the provisions in the Income tax laws can be used for tax planning.

CO2; Students of the subject will be able to explain different types of incomes and their taxability and expenses and their deductibility.

CO3: Students of the course will able to state the use of various deductions to reduce the taxable income.

Focus: provisions in the Income tax laws can be used for tax planning.

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

BCLC 4004: PRINCIPLES & PRACTICES OF BANKING & INSURANCE

OBJECTIVES:

To enable the students in getting an outlook of how banking & insurance businesses work on day-to-day basis and how things are done in a professional business set up.

Credits: 05 **Trimester VIII** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
I	**Introduction to Banking & Insurance**: Introduction to Insurance: Meaning of Insurance, Nature, Functions, Purpose and need of insurance. Principles of Insurance, kinds of insurance, advantages of insurance, Comparison of Life insurance, with other Insurances, globalization of insurance and insurance sector reforms in India. Concept of Banking, Types and Functions of Banks, Structure and organization of banks. Rights, duties and obligations of the banker. Banker and customer and their relationships. **Principles & Practices of Insurance**: Contract of Insurance, Regulatory Body-IRDA:-functions, powers, and role. Different Classifications of insurance. **Life Insurance**: Nature and Significance of Life Insurance, Essentials of Life Insurance Contracts, Types of Life Insurance Policies & products. **General Insurance**:- Nature and Significance of General Insurance, Essentials of General Insurance Contracts, Claims Management, Risk Assessment & Underwriting, Premium Setting, Comparison of Life Insurance with other Insurances. **Miscellaneous Insurance:** Motor Insurance, Burglary and Fidelity Insurance. Crop and Cattle Insurance.	24
II	**Principles and Practice of Banking**: Various types of Bank Customers, Procedure and precaution for opening an account, Know your customer (KYC), Principles of lending; various credit facilities, Different kinds of Deposit Product, modes of creating charges. Reserve Bank of India: Role of RBI and their functions. Commercial Banks – Functions – E-Banking, ATM Cards , Debit Cards, Personal Identification Number – Online Enquiry ,and updatefacility-Electronic Fund Transfer- Electronic Clearing System. Emerging trends in Banking Sector (Mobile banking, UPI)	24

LEARNING OUTCOMES:

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

CO1: Understand about banking & insurance & its importance in today's business world.
CO2: Understand the main concepts and principles of banking & insurance
CO3: Build a theoretical basis for their knowledge in other areas of banking & insurance

Focus: main concepts and principles of banking & insurance

REFERENCE BOOKS:

- Mishra M.N: Insurance Principles and Practice; S.Chand and Co. New Delhi
- Maheshwari, S.N. and Maheshwari, S.K. (2005), Banking Law and Practice, Kalyani Publishers, New Delhi.
- Vinayakam N., Radhaswamy and Vasudevan SV; Insurance- Principles and practice, SChand and Co.New Delhi.
- JyotsnaSethi,Nishwanbhatia,ElementsofBankingandInsurance,PHILearningPvt.Ltd

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2

BCLC 3001: COST ACCOUNTING

OBJECTIVES:

The objectives of studying this course are-

- To understand various techniques and methods of cost accounting.
- To defines the concepts of cost, expense, loss and revenue
- To calculates labor costs and records them
- To be able to interpret cost accounting statements
- To be able to analyze and evaluate information for cost ascertainment, planning, control and decision making
- To illustrate the methods of cost reductions and cost control for the objective of maximizing profit for an organization

Credits: 05 **Trimester VII** **L–T–P: 4–1–1**

Module No.	Content	Teaching Hours
MODULE - I	**Basic Concepts Of Costing:** Meaning of Costing, Objectives of Cost Accounting, Functions of Cost Accountant, Advantages of Cost Accounting, Objections to Cost Accounting, Elements of Cost, Types of Costing, Cost Classification, Methods of Costing, Costing system and implementation. Principles of Cost Accounting, Advantage Disadvantage of Cost Accounting Terms used in Costing (cost concepts for decision making)**Unit Costing:** Preparation of Simple cost Sheet/cost statement, determination of cost and price of product or object (Only single product costing), Preparation of Production account, Tender Cost Sheet (Estimated Cost Sheet)	**24**
MODULE – II	**Budget and Budgetary Control:** Definition, Meaning and 6 objectives of Budgetary control, Advantages and disadvantages of Budgetary Control Types of Budget **Marginal Costing:** Meaning and Various Concepts - Fixed Cost 6 Variable Cost, Contribution, P/V Ratio, Break Even Point, Margin of Safety **Standard Costing:** Definition and Meaning of Various Concepts 6 Advantages and Limitations of Standard Costing Variance Analysis – Material and labour Variances only **Overhead Costing**: Defintion, Meaning and Analysis	**24**

TEXT BOOK:

- Cost Accounting Text and Problems by M. C. Shukla, T. S .Grewal and M. P. Gupta –S Chand –10th Edition
- Cost Accounting by V. Rajshekharan and R. Lalitha, Pearson publication. Latest edition

REFERENCE BOOKS:

- Management Accounting by Paresh Shah –Oxford University Press
- Cost Accounting by J. Made Goda –Himalaya Publishing House –1st Edition
- Cost Accounting by Jawahar Lal & Seema Srivastava –Tata McGraw Hill Publication

LEARNING OUTCOMES:

CO1: The student will be able to describe how cost accounting is used for performance evaluation.
CO2: The student will be able to explain the basic concept of cost and how costs are presented in financial statements.
CO3: The student will be able to outline a budget and use budgets for performance evaluation after flexing the budget.
CO4: The student will be able to interpret variable cost variances and fixed cost variances.

Focus: basic concept of cost and how costs are presented in financial statements.

Mapping of Programme Educational Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAMME EDUCATIONAL OBJECTIVE**			
	1	**2**	**3**	**4**

CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

Mapping of Program Specific Objectives with Course Outcomes

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

COURSE OUTCOMES	**PROGRAM SPECIFIC OBJECTIVES**			
	1	**2**	**3**	**4**
CO1	2	3	2	3
CO2	2	2	3	2
CO3	3	2	2	2
CO4	2	2	2	3

COURSES OFFERED

(w.e.f. Session 2020-21)

PHD LAW

Law and social transformation in India

Subject Code: PLAW 0020

Objectives: This course is designed to create awareness in the students about the Indian approach to social and economic problems and to address the remedial measures through Law as an instrument of social control and change.

Course Learning Outcomes:

CLO 1: To familiarize the student with the importance of Law as an instrument of social change
CLO 2: Develop an understanding about Law as the product of traditions and culture.
CLO3: About the introduction of common law system and institutions in India and its impact on further development of law and legal institutions in India.

Credits:04 **L-T;3-1**

ModuleNo.	Content	TeachingHours
I	**Law and Social Change:** Law as an instrument of social change Law as the product of traditions and culture, Criticism and evaluation in the light of Colonization and the introduction of common law system and Institutions in Indian and its Impact on further development of law and legal institution in India. **Religion and the Law:** Religion as a divisive factor. Secularism as a solution to the problem. Reform of the law on secular lines; Problem. Freedom of religion and non-discrimination on the basis of religion. Religion, minorities and the law. **Language and the Law:** Language as a divisive factor. Constitutional guarantees to linguistic minorities. Language policy and the Constitution: Official language; multi-language system. Non- discrimination on the ground of language.	**15**

II	**Women and the Law:** Empowerment of women: Constitutional and other legal provisions. Women's commission. Gender injustice and its various forms. **Children and the Law:** Children and education. Adoption and related problems. Sexual exploitation. Child labour **Modernization and the Law:** Modernization as a value: constitutional perspectives reflected in the fundamental duties. Modernization of social institutions through law. Democratic decentralization and local self-government. Social is thought on law and justice. An enquiry through constitutional debates on the Right to property	**15**

Focus: It is focused on the social and economic changes in law.

TEXTBOOKS

1. Marc Galanter (ed)Law and Society in Modern India
2. U.Baxi, The Crisis of the Indian Legal System(1982)Vikas, NewDelhi
3. U.Baxi(ed)Law and Poverty Critical Essays(1988)Tripathi, Bombay
4. H.M. Seervai, Constitutional Law of India(1996)Tripathi
5. D.D.Basu, Shorter Constitution of India(1996)Prentice –Hall of India(P)Ltd, New Delhi
6. Dr. G.P. Tripathi: Law & Social Transformation

Emerging Challenges in Law

Subject Code: PLAW0021

Objective:

Legal education is a species of main stream education involving the study of law. It inculcates the ability to make use of law, to analyze it and to criticize it as a member of the legal community. It focuses on the individual freedom as also on the development of society, solidarity and strengthening of rule of law

Course Learning Outcomes:

CLO1: To familiarize the student to the critical issues relating to law.

CLO 2: Introduces the research attitude and logical reasoning amongst the research scholar and toenhance their capabilities to critically analyze and examine the new laws and the challenges posted by them.

Credits:04 **L-T;3-1**

ModuleNo.	Content	TeachingHours
I	**Law and its Role in Society:** Law as a tool of policy and social transformation. Role of law reflecting social change-Reflection between law and public opinion. Law and social control- Limit ofeffectiveness of law(principles of SocialLegislation) Relation between Law and Morality- Social Morality vis-à-vis Constitutional Morality. **Reform in Criminal Justice System:** Need for reform in criminal justice system. Prison reform and challenges, Human rights of prisoner Police Reform and Challenges. Issues of Judicial Reform in India.	**15**

II	**Disadvantage Group Right and Role Of State:** International and National Instrument for Empowerment of Women. Position and Role of Women in Indian Society-Jurisprudential Dimensions of Gender Injustice and its various forms. Women and Human Rights. Saving Childhood through Welfare Labour Legislation. **Law relating to Cyber space:** Cyber space: Issues and Challenges Right to Privacy in 21st Century. Impact of Information Technology on Indian Judiciary. Artificial Intelligence. **Fundamentals of Environment Protection:** Emerging Issues in Environmental Law Fundamental Principles of Environmental Protection Constitutional perspective of Environmental Protection. Environmental Dispute Resolution. Environmental Rights and Human Rights.	**15**

Focus: it is focus on the current issues and challenges in the law.

TEXTBOOKS

- OliverMendelsohn,LawandsocialtransformationinIndia(OxfordUniversity,Press,2014)
- BruceP.FrohenandGeorgeW.Carey,ConstitutionalMoralityandtheriseofQausi-law(HarwardUniversityPress,US.2016)
- Jhon Rawls, A Theory of Justice(HarwardUniversityPress,US,1971)
- Amartya Sen,The ideal of Justice(HarwardUniversityPress,US,2009)
- Gaur,EmpowermentofWomeninIndia(LawPublishersPvt.Ltd.,Allahabad,2005)
- UshaTandon(ed.)GenderJustice:ARealityorFragileMyth?(RegalPublication,NewDelhi, 2015)
- Burns H. Weston (ed), Child Labor and Human Rights: Making Children Matter (LynnePiblishers,2005)

- H.L. Kumar, Practice and Procedures of Labour Laws (LexisNexis, New Delhi, 5th Edition.2020)
- Vibhute K.I., Criminal Justice :AHumanRightPerspectiveoftheCriminalJusticeProcessinIndia(EasternBookCo.,Newdelhi.1st Edition,2004)
- Prathapan P, Mahatma Gandhi on Prison Reform, (PartridgePublishing,India,1st Edition,2015)
- Kathpalia Girjesh, Criminology and Prison Reforms, (LexisNexis,India,1stEdition2014)
- Goswamy Subhrangsu, Debroy Bibek, Judicial reforms in India, (AcademicFoundation,India,2007)
- JusticeYatindraSingh,CyberLaws (universalLawPublishingCo.,NewDelhi,2012)
- P.Leelakrishnan,EnvironmentalLawinIndia(LexisNexis,India,2ndEdition2005)

B.Sc. (HONS.)
(BIOTECHNOLOGY)
COURSE CURRICULUM

(w.e.f. Session 2020-21)

INSTITUTE OF APPLIED SCIENCES&HUMANITIES

Table of Contents

COURSE STRUCTURE

B.Sc. (HONS.)

BIOTECHNOLOGY

First Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0001	Chemistry I	Core	4	0	0	4	4
2.	BSBC 0002	Cell Biology	Core	4	0	0	4	4
3.	BELH 0005	Remedial English	AECC1	2	2	0	3	4
4.	BMAS 0501 BSBO 0001	Biostatistics Remedial Biology	GE1	4	0	0	4	4
PRACTICALS								
5.	BSBC 0801	Chemistry I Lab	Core Lab	0	0	3	2	3
6.	BSBC 0802	Cell Biology Lab	Core Lab	0	0	3	2	3
7.	BSBO 0801	Environmental Biotechnology Lab	GE1 Lab	0	0	3	2	3
TOTAL				14	02	09	21	25

Second Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0003	Biomolecules	Core	4	0	0	4	4
2.	BSBC 0004	Chemistry II	Core	4	0	0	4	4
3.	BSBC 0005	Environmental Science	AECC2	2	2	0	3	4
4.	BSBO 0002	Computer Fundamentals and Applications	GE2	4	0	0	4	4
PRACTICALS								
5.	BSBC 0803	Biomolecules Lab	Core Lab	0	0	3	2	3
6.	BSBC 0804	Chemistry II Lab	Core Lab	0	0	3	2	3
7.	BSBO 0802	Computer Application in Biotechnology Lab	GE2 Lab	0	0	3	2	3
TOTAL				14	02	09	21	25

Third Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0006	Molecular Biology	Core	4	0	0	4	4
2.	BSBC 0007	Plant Science I	Core	4	0	0	4	4
3.	BSBC 0008	Biochemistry	Core	4	0	0	4	4
4.	BSBC 0009	Stem Cell Technology	SEC1	2	0	0	2	2
5.	BSBO 0003	Bioinformatics	GE3	4	0	0	4	4
PRACTICALS								
6.	BSBC 0805	Molecular Biology Lab	Core Lab	0	0	3	2	3
7.	BSBC 0806	Plant Science I Lab	Core Lab	0	0	3	2	3
8.	BSBC 0807	Biochemistry Lab	Core Lab	0	0	3	2	3
9.	BSBO 0803	Bioinformatics Lab	GE3 Lab	0	0	3	2	3
TOTAL				18	00	12	26	30

Fourth Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0010	Instrumentation and Bio - Analytical Techniques	Core	4	0	0	4	4
2.	BSBC 0011	Microbiology	Core	4	0	0	4	4
3.	BSBC 0012	Immunology	Core	4	0	0	4	4
4.	BSBC 0013	Drug Discovery & Development	SEC2	2	0	0	2	2
5.	BSBO 0004	Clinical Microbiology	GE4	4	0	0	4	4
PRACTICALS								
6.	BSBC 0808	Instrumentation and Bio - Analytical Techniques Lab	Core Lab	0	0	3	2	3
7.	BSBC 0809	Microbiology Lab	Core Lab	0	0	3	2	3
8.	BSBC 0810	Immunology Lab	Core Lab	0	0	3	2	3
9.	BSBO 0804	Clinical Microbiology lab	GE4 Lab	0	0	3	2	3
TOTAL				18	00	12	26	30

Fifth Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0014	Plant Biotechnology	Core	4	0	0	4	4
2.	BSBC 0015	Recombinant DNA Technology	Core	4	0	0	4	4
3.	DSE1	Discipline Specific Elective 1	Elective	4	0	0	4	4
4.	DSE2	Discipline Specific Elective 2	Elective	4	0	0	4	4
PRACTICALS								
5.	BSBC 0811	Plant Biotechnology Lab	Core Lab	0	0	3	2	3
6.	BSBC 0812	Recombinant DNA Technology Lab	Core Lab	0	0	3	2	3
7.	DSE1	Discipline Specific Elective 1 Lab	Elective Lab	0	0	3	2	3
8.	DSE2	Discipline Specific Elective 2 Lab	Elective Lab	0	0	3	2	3
TOTAL				16	00	12	24	28

Six Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0016	Animal Biotechnology	Core	4	0	0	4	4
2.	BSBC 0017	Genomics & Proteomics	Core	4	0	0	4	4
3.	DSE1	Discipline Specific Elective 1	Elective	4	0	0	4	4
4.	DSE2	Discipline Specific Elective 2	Elective	4	0	0	4	4
PRACTICALS								
5.	BSBC 0813	Animal Biotechnology Lab	Core Lab	0	0	3	2	3
6.	BSBC 0814	Genomics & Proteomics Lab	Core Lab	0	0	3	2	3
7.	DSE1	Discipline Specific Elective 1 Lab	Elective Lab	0	0	3	2	3
8.	DSE2	Discipline Specific Elective 2 Lab	Elective Lab	0	0	3	2	3
9.	BSBC 0815	Project Training		For two month			5	35
TOTAL				16	00	12	29	63

DETAILS OF DISCIPLINE SPECIFIC ELECTIVE (DSE)

Fifth Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBE 0004	Chemistry-III	Elective	4	0	0	4	4
2.	BSBE 0005	Genetics	Elective	4	0	0	4	4
3.	BSBE 0006	Plant Science II	Elective	4	0	0	4	4
4.	BSBE 0007	Food and Industrial Biotechnology	Elective	4	0	0	4	4
5.	BSBE 0008	Enzymology	Elective	4	0	0	4	4
6.	BSBE 0009	Evolution and Ecology	Elective	4	0	0	4	4
PRACTICALS								
7.	BSBE 0804	Chemistry-III Lab	Elective Lab	0	0	3	2	3
8.	BSBE 0805	Genetics Lab	Elective Lab	0	0	3	2	3
9.	BSBE 0806	Plant Science II Lab	Elective Lab	0	0	3	2	3
10.	BSBE 0807	Food and Industrial Biotechnology Lab	Elective Lab	0	0	3	2	3
11	BSBE 0808	Enzymology Lab	Elective Lab	0	0	3	2	3
12.	BSBE 0809	Evolution and Ecology Lab	Elective Lab	0	0	3	2	3

DETAILS OF DISCIPLINE SPECIFIC ELECTIVE (DSE)

Six Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBE 0010	Fermentation Technology	Elective	4	0	0	4	4
2.	BSBE 0011	Role of Biotechnology in Forensic Science	Elective	4	0	0	4	4
3.	BSBE 0012	Developmental Biology	Elective	4	0	0	4	4
4.	BSBE 0013	Human Physiology	Elective	4	0	0	4	4
5.	BSBE 0014	Environmental Biotechnology	Elective	4	0	0	4	4
6.	BSBE 0015	Clinical Biochemistry	Elective	4	0	0	4	4
PRACTICALS								
5.	BSBE 0810	Fermentation Technology Lab	Elective Lab	0	0	3	2	3
6.	BSBE 0811	Role of Biotechnology in Forensic Science Lab	Elective Lab	0	0	3	2	3
7.	BSBE 0812	Developmental Biology Lab	Elective Lab	0	0	3	2	3
8.	BSBE 0813	Human Physiology Lab	Elective Lab	0	0	3	2	3
9.	BSBE 0814	Environmental Science Lab	Elective Lab	0	0	3	2	3
10.	BSBE 0815	Clinical Biochemistry Lab	Elective Lab	0	0	3	2	3

S. No.	Category	Subject	Credit	Total Credits
1	Core (Theory)	14	4	56
2	Core (Lab)	14	2	28
3	AECC	2	3	6
4	SEC	2	2	4
5	DSE (Theory)	4	4	16
6	DSE (Lab)	4	2	8
7	GE (Theory)	4	4	16
8	GE (Lab)	4	2	8
9	Project Training	1	5	5
	Total Credits			147

SYLLABUS

B.Sc. (HONS.) BIOTECHNOLOGY

BSBC 0001: CHEMISTRY – I

OBJECTIVES: Impart sufficient qualitative/quantitative analytical and synthetic chemical knowledge and skills to students. Impart a disciplined approach to conceptualizing chemical problems in numerical terms. Predict products of chemical reactions. Explain patterns of chemical reactions.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Organic Chemistry as Chemistry of Carbon Compound :** Methods of purification, tests of purity, qualitative and quantitative elements analysis, determination of Molecular masses calculation of empirical and molecular formula, structural formula, functional groups and Nomenclature. **Reaction intermediates, Organic reactions, and Mechanism of Nucleophillic Substitution reactions :** Types of Organic reactions,Freeradicals,carbonium ion, carbanion, attacking reagents, Mechanism of Organic reactions, Nucleophillic substitution reactions, Electrophillic substitution reactions, Addition reactions, Elimination reactions. **Periodic Table and Periodic Properties:** Atomic and Ionic Radii, ionization energy, Electron affinity and Electro negativity, definition, Methods of determination, trends in periodic table and application in predicting and explaining the Chemical Behaviour.	18
II	**Chemical Bonding:** Ionic Bond, Covalency, Co-ordinate Valency Polar and non-polar covalent Bonds, Fazan's rule, Octet rule, Hybridization Rules for the calculation of Hybridization Valence shell electron pair repulsion theory, shapes of covalent molecules, Molecular Orbital theory, Hydrogen Bond, Vanderwaals forces, Bond strength and Bond energy. **Chemical Kinetics and Catalysis – Introduction:** Chemical Kinetics and its scope, rate of a reaction, Factor influencing rate of reaction velocity or rate constant, order of reaction, Molecularity, Psuedomoleecular reactions, Zero Order reactions, First Order reactions. Second order reactions, determination of order of reaction, Arrhenius equation concept of Activation energy, Activation energy and Chemical and Chemical reactions. **Theory of Chemical Kinetics :**	24

	Smaller size effect of temperature on rate of reaction, simple collision theory of Bimolecular reactions, catalysis, characteristics of catalyzed reactions classification of catalysis, Enzyme Catalysis, Promoters and poisons. **Phase Rule :** Gibb's phase rule, one component system, water and sulphur systems:-	

Text book:

1. M.M.N. Tandon, "Unified Chemistry for B.Sc. First Year": Shivlal Agarwal & Co., 2016

Reference books:

1. S.Glasstone, "Textbook of Physical Chemistry": D. Van Nostrand Co., Princeton, NJ , 1961
2. R.D.Madan, "Modern Inorganic Chemistry": S. Chand Publishing, 2019
3. I.L. Finar, "Organic Chemistry Vol. 1":Pearson, 2002

Focus: This course focuses on Employability aligned with CO1

Course outcomes: After completion of course, the student will be able to:
CO.1.Understand reaction mechanism, elemental analysis, fundamental concept of chemical kinetics and chemical bonding
CO.2. Students will master basic research skills.
CO.3. Student will understand the importance of the Periodic Table of the Elements, how it came to be, and its role in organizing chemical information.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO2, PSO3
CO2	PO1, PO2, PO4/PSO1, PSO3
CO3	PO6, PO7,PO8/PSO2

BSBC0002: CELL BIOLOGY

OBJECTIVES: Cell biology is increasingly important in all life sciences. Many of the advancements in modern science are the result of a better understanding of cellular components and their functions.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Cell- basic unit of life**: Discovery of cell, Cell theory, Cell shape & Morphology. **Cell types**: Classification of cell types (Prokaryotic and Eukaryotic cells) and their differences. **Plant and Animal cells**: Structure of Plant and Animal cells and their differences. **Cell Wall & Plasma membrane**: Ultra structure and function of cell wall and plasma membrane. **Cellular Organelles:** Ultra structure and function of cellular organelles (Mitochondria, Endoplasmic reticulum, Ribosomes, Golgibodies, Lysosomes. Plastids , Peroxisomes & Glyoxysomes **Nucleus** :Ultra structure and function of nucleus. **Chromosomes:** Morphology and structural organization. Nucleosome model. Euchromatin and heterochromatin. Karyotyping and banding pattern.	14 18
II	**Special chromosome:** Salivary gland and Lamp brush chromosomes. **Cytoskeleton:** Microtubules, Intermediate filaments, Microfilaments. Centrioles & Basal bodies. **Cytosol:** Biochemical composition of cytosol. **Cell cycle:** Cell cycle and its regulation. **Cell division**: Mitosis & Meiosis their mechanisms and differences. **Different type of cells:** Totipotent cell, Pluripotent cells, Stem cells, Blood cells. **Cell locomotion** (Amoeboid, Ciliary, & Flagellar). **Cancerous cells:** Differences between normal cells and cancerous cells.	24

Text Book: Cytology, Genetics & Molecular Biology by Gupta, P.K

Reference Books:

- Cell Biology - S.C. Rastogi
- Cell and Molecular Biology - De Robertis
- Cell and Molecular Biology - Lodish

- Cytology, Genetics and mol. Biology - P.K. Gupta
- Biotechnical cell biology - Veer Bala Rastogi
- Cell biology, Genetics, Mol. Biology, - P.S.Verma & V.K. Agrawal
- Mol. Biology of cell - Albert et al
- The Cell -Cooper

Focus: This course focuses on Employability aligned with CO2

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

CO1- To understand Knowledge of cell structure and function

CO2- To understand the metabolic processes of cells in terms of cellular organelles, membranes, and biological molecules.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO7, PO8/PSO1, PSO3
CO2	PO1, PO2, PO4/PSO2, PSO3

BELH 0005: REMEDIAL ENGLISH

COURSE OBJECTIVE

The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.

Credits: 03 **Semester: I** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**APPLIED GRAMMAR** **A.1. i. Tense and Voice:** Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change. **ii. Parts of Speech:** Noun: countable and uncountable; Pronoun: Personal Pronoun; Adjective; Adverb; Preposition **A.2. Reading Comprehension** **i. Analyzing a Text:** Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures & vocabulary; Analysis of the content of the text: interactive session. **ii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	**20**
II	**B.1. Reading Comprehension** **i. Analyzing a Text** Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures & vocab; Analysis of the content of the text: interactive session. **ii. Reading an Essay:** Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers. **iii. Analyzing Unseen Passages:** Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure	**25**

	B.2. Narration: Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech. **B.3.THEME BASED WRITING** Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings and Places, Car Parts , City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey), Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House, Restaurant, Tools, Transportation, Vegetables, Weather	

Text Books:

- Murphy, Raymond, *Intermediate English Grammar.* Cambridge University Press.
- Robert J. Dixon. *Complete Course in English.* A new revised edition

References:

- Hornby, A.S., *Advanced Learners' Dictionary of Current English,* OUP
- Greenberg, Rondinone & Wiener. *The Advancing Writer Book I,* Harper Collins, College Publishers.
- Liz and Soars. *Headway Pre-Intermediate*. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup & Sons, Delhi 2003

Course outcomes: After completing the course students will be able to:

CO1- Comprehend a text and answer the questions based on it clearly.
CO2- Express their ideas in writing according to time and tense.
CO3- Enrich their vocabulary in terms of contextual and situational conversation.
CO4- Enhance their listening skills through the video of the text.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO2, PSO3
CO2	PO1, PO2, PO4/PSO1, PSO3
CO3	PO6, PO7,PO8/PSO2, PSO3
CO4	PO3, PO6,PO7/PSO1

BMAS 0501: BIOSTATISTICS

OBJECTIVES: To make the students understand the concept of biostatistics, probability, calculus and algebra.

Credits: 04 **Semester: I** **L–T–P: 4–0–0**

Module	Contents	Hrs.
I	Logarithms, Introduction and simple problems on Differentiation, Integration (excluding trigonometric functions), Scalar and Vector quantities, Types of vectors, Addition and Subtraction of vectors, Scalar and Vector product of two vectors, Types of matrices, Operations on matrices (addition, subtraction and multiplication etc.). Introduction to Biostatistics, Data collection, Tabulation and Classification of data, Frequency distributions	18
II	Diagrammatical & Graphical representation of data, Measures of Central tendency and Dispersion, Introduction TEXT to Probability (simple problems).Correlation between two variables, Karl Pearson's formula for finding correlation coefficient, Rank correlation, Regression lines, Fitting of straight line & second degree parabola by the method of least squares, Population and sample, Testing of hypothesis, Level of significance, t-test, Chi-square test as a goodness of fit.	24

Text books:

- P. Banerjee, Introduction to Biostatistics, S. Chand & Co., Delhi, 2006.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- H. Kishan, Differential Calculus, Atlantic Publishers and Distributors, Delhi, 2008.
- H. Kishan, Integral Calculus, Atlantic Publishers and Distributors, Delhi, 2005.

Reference books:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- B. K. Mahajan, Methods in Biostatistics, Jaypee Publications, New Delhi, 2010.

Focus: This course focuses on Skill development aligned with CO1

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

CO1- Attain a basic proficiency in quantitative skills, understand and critically assess data collection and its representation

CO2- Get the knowledge of averages, measures of dispersion to interpret the data
CO3- Understand the correlation between the two variables and concept of regression lines
CO4- Test the hypothesis and apply t and Chi–square tests

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

COs	POs/ PSOs
CO1	PO1, PO3, PO7, PO8/PSO1, PSO3
CO2	PO1, PO2, PO4/PSO2, PSO3
CO3	PO3, PO7, PO8/PSO1, PSO3
CO4	PO1, PO6/PSO2

BSBO 0001: REMEDIAL BIOLOGY

OBJECTIVES: This is an introductory course in biology which gives detail study on natural sources of plant and animal origin. Subject deals with the plant cell, animal cell classifications plant kingdom and study of animal issues.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module	Contents	Hrs.
I	• Cell,Cell types,Cell Wall & Plasma membrane • Cellular Organelles: Ultra structure and function of cellular organelles • Nucleus:Ultra structure and function of nucleus. • Chromosomes • Cytosol • Cell cycle,Cell divisio. • Methods of classification of plants • Morphology, anatomy and functions of different parts of Root, leaf, stem, flower, seed • Tissues in plants	14 18
II	• Transportation, photosynthesis and respiration in plants • Plant growth and developments • Structure of plant cell • Classification of living organism • Concept of animal and plant classification • Systematic and binomial system of nomenclature • Viruses • Animal kingdom • Structure and life history of insects like mosquito, house fly , silk worm.	24

Text book:

- Cell biology, S.C. Rastogi Rastogi publication

Reference books:

- Biotechnical cell biology,Veer Bala Rastogi, rastogi publication
- Cell biology, Genetics, Mol. Biology, P.S.Verma & V.K. Agrawal, S. Chand publication

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

CO1- Student will learn details about plant and animal cells plan taxonomy classification

CO2- To understand some aspects of physiology of animals.

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

COs	POs/ PSOs
CO1	PO3, PO4, PO7, PO8/PSO1, PSO3
CO2	PO1, PO2, PO4/PSO2, PSO3

BSBC 0801: CHEMISTRY- I LAB

OBJECTIVES: Predict products of chemical reactions. Explain patterns of chemical reactions. Demonstrate common chemical laboratory techniques, chemical instrumentation and other appropriate technology. Demonstrate ability to work in a cooperative environment, understanding of safe laboratory practice.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module	Contents	Hrs
I	**Physical:** 01. Determination of Surface Tension (using Stalagmo meter) 02. Determination of Viscosity (using viscometer) 03. Solubility Determination of (i) KNO_3 (ii) Benzoic acid (iii) Oxalic acid (iv) Sodium sulphate **Inorganic :** **Volumetric Analysis**: 01.Oxidation – Reduction titrations (i) Strength of an oxalic acid solution. (ii) Strength of ferrous ammonium sulphate (Mohr's salt) solution. 02. Iodometry titrations (i) Strength of an copper sulphate solution. (ii) Strength of potassium dichromate solution.	30

Focus: This course focuses on Employability & Skill development aligned with CO1 & CO2

Course outcomes: After completion of course, the student will be able to:
CO1- Students will understand chemical reactions in terms of structure and analytical knowledge
CO2- Students will master in basic research skill.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO7, PO8/PSO1, PSO3
CO2	PO3, PO5, PO4/PSO2

BSBC 0802: CELL BIOLOGY LAB

OBJECTIVES: Describe levels of organization and related functions in plants and animals cells, function and structure of cells, different staining technique etc.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module	Contents	Hrs.
I	Techniques involved in cell biology. Staining of different type of cells (prokaryotes & Eukarytoes) Gram staining for gram positive and negative bacteria. Test for the presence of cellulose, cutin wax and phenolics. Study of plant tissues (Dicot/ monocot stem & root) by staining . Differential staining of blood cells, (DLC) Use of micrometer and calibration. Measurement of onion epidermal cells. Isolation of chloroplast/ mitochondria from cell homogenate. Examination of various stages of mitosis and meiosis using appropriate plant material.	30

Focus: This course focuses on Skill development aligned with CO1 & CO2

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

CO1- To understand basic staining techniques

CO2- To understand morphology and taxonomy of plant tissues

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

COs	POs/ PSOs
CO1	PO1, PO2, PO7, PO8/PSO1, PSO3
CO2	PO3, PO5, PO6/PSO2, PSO3

BSBO 0801: ENVIRONMENTAL BIOTECHNOLOGY LAB

OBJECTIVES: Course provides introduction to environmental biotechnology and focuses on the utilization of microbial processes in waste management, water and effluent treatment and bioremediation. Topics include microbial energy metabolism, microbial growth, approaches for studying microbial communities, basic principles of bioremediation, water and waste treatment.

Credits: 02 **Semester I** **L–T–P: 0-0-3**

Module	Contents	Hrs.
I	• Introduction to laboratory and Instruments. • Determination of soil and water health care. • Determination of total dissolved solids of the water samples. • Determination of hardness of water samples. • Determination of chlorine in the water samples. • Determination of dissolved oxygen of the water samples. • Determination of biological oxygen demand of the water samples. • Determination of chemical oxygen demand of the water samples. • Determination of total bacterial population from air, water and food samples.	30

Focus: This course focuses on Skill development aligned with CO1 & CO2

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

CO1- To describe the most commonly applied disinfection methods and the steps typically involved in drinking water treatment process.

CO2- They also able to evaluate the potential for biodegradation of organic pollutants, microbial and physical/chemical environments.

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

COs	POs/ PSOs
CO1	PO2, PO5, PO7, PO8/PSO1, PSO3
CO2	PO1, PO3, PO6/PSO2, PSO3

BSBC 0003: BIOMOLECULES

OBJECTIVES: To teach students about important biomolecules essential to life processes.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Basic aspects of the chemistry of life:** bonding properties of carbon, asymmetry of carbon compounds, basic concept of pH, pKa, buffers, various bonds stabilizing biomolecules (peptide, glycosidic, ester, phosphodiester, disulfide, ionic, hydrogen, hydrophobic, vanderwall's force), water as a solvent of life **Bioenergitcs:** I and II laws of thermodynamics, high energy phosphate compounds (ATP, creatine phosphate, thioesters), oxidative phosphorylation (chemiosmotic hypothesis, ATP synthase, P/O ratio, uncoupling), photophosphorylation **Carbohydrates:** chemical structures, classification, physiochemical properties and importance in biological cells **Amino acids:** chemical structures, classification, physiochemical properties, zwitterions nature, glucogenic and ketogenic amino acids **Proteins:** classificationbasedon source, shape, composition and function, structural organization of proteins (primary, secondary, tertiary and quaternary structures), physiochemical properties	18
II	**Enzymes:** nomenclature and classification, characteristics of Enzymes, mode of Enzyme action (lock and key hypothesis, induced fit hypothesis),Enzyme kinetics, derivation of Michaelis- Menten equation, **Lipids:** chemical structures, classification, physiochemical properties and functions **Nucleic acids:** structures of nitrogenous bases (adenine, guanine, thymine, cytosine and uracil), nucleotides and nucleosides, DNA secondary structure **Vitamins:** classification and functions **Phytochemistry:**Extraction methods, Qualitative & Quantitative methods, structure, classification, properties & therapeutic application of Secondary metabolites	24

Text book:

- J.L. Jain, S. Jain and N. Jain, "Fundamental of Biochemistry": S. Chand & Company Pvt. Ltd, 2016

Reference books:

- J. M. Berg, L. Stryer, J. L Tymoczko and G.J. Gatto, "Biochemistry" : W.H. Freeman, 2015
- D.L. Nelson and M. Cox, "Lehninger Principles of Biochemistry" : W.H. Freeman,
- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

Focus: This course focuses on Skill development aligned with CO2 & CO3

Course outcomes: The major outcomes of this course are:

CO1- To understand basic fundamentals aspect of Biomolecules, which will help students to know about concept of Biochemistry.

CO2- Describe the structure, chemical and functional aspects of carbohydrates, proteins, lipids and nucleic acid.

CO3- To understand phytochemistry, which enables students to explore traditional medicinal values of various plants.

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

COs	POs/ PSOs
CO1	PO1, PO4, PO5 /PSO2, PSO3
CO2	PO2, PO4, PO6 /PSO1, PSO3
CO3	PO1, PO3, PO4 /PSO2, PSO3

BSBC 0004: CHEMISTRY- II

OBJECTIVES: Impart sufficient qualitative/quantitative analytical and synthetic chemical knowledge and skills to students. Impart a disciplined approach to conceptualizing chemical problems in numerical terms .Predict products of chemical reactions. Explain patterns of chemical reactions.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Stereo Chemistry of Organic Compounds :** Structural Isomerism, Stereo Isomerism, Optical Isomerism, Optically active compound without cherality, Resolution of Racemic Modifications, Geometrical Isomerism, R.S. System of Configuration of optical isomers, E1 Z system of configuration of geometrical isomers, conformational Isomerism. **General Methods of preparation and properties** of alkanes, alkenes, alkynes, halogen substituted alkanes (CH_2Cl_2,$CHCl_3$, CCl_4). **Aldehydes & Ketones:** Nomenclature and structure of the carbonyl group, synthesis of aldehydes and Ketones.Chemical reactions of the carbonyl group.Unsaturated aldehydes and ketones.	18
II	**Alcohols & Phenols:**Classification and nomenclature, Monohydric Alcohols, nomenclature, methods of foundation by reduction of aldehydes and Ketones, carboxylic acid and esters, Hydrogen Bonding, Acidic nature, reaction of alcohol Nomenclature, Structure and Bonding, Preparation of phenols, Physical properties and acidic character comparative acidic strength of alcohols and phenols, resonance stabilization of Phenoxide ion, Reactions of Phenols. **Chemistry of S- and p-block elements:** Comparative study, diagnol relationship, salient feature of hydrides and complexation tendencies including their function in Biosystem.	24

	Polymers: Preparation, Properties, Classification and uses of the following polymers, Polystyrene, Polyacrylonitrile, Polymethacrylate, Polymethylmethacrylate, Polyethene, Polybutadiene, Polyvinylidene, Polycarbonates, Polyesters, Polyurethanes, Nylon, Phenolic polyesters, Polyamides, Polysulphones,	

Text book:

1.M.M.N. Tandon, "Unified Chemistry for B.Sc. Second Year": Shivlal Agarwal & Co., 2016

Reference books:

2. J. D. Lee, "Concise Inorganic Chemistry": Wiley, 2008

3. R.D.Madan, "Modern Inorganic Chemistry": S. Chand Publishing, 2019

4. I.L. Finar, "Organic Chemistry Vol. 1":Pearson, 2002

Focus: This course focuses on Employability aligned with All COs

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

CO1- Understand Stereochemistry of organic compounds, General methods of preparation and properties of alkanes, alkenes and alkynes
CO2- Understand fundamental concept of alcohol, aldehydes, ketones and chemistry of S and P block element
CO3- Understand preparation, properties, classification and uses of Polymers

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

COs	POs/ PSOs
CO1	PO1, PO4, PO5, PO6/PSO2, PSO3
CO2	PO2, PO3, PO6/PSO1, PSO3
CO3	PO1, PO4, PO7, PO8/PSO2

BSBC 0005: ENVIRONMENTAL SCIENCE

OBJECTIVES: Recognize major concepts in environmental sciences and demonstrate in-depth understanding of the environment. The environmental science major prepares you for career success in natural resources and conservation, public health, environmental monitoring and remediation, industrial environmental management, or research or education of environmental science.

Credits: 03 **Semester II** **L–T–P: 2–2–0**

Module No.	Content	Teaching Hours
I	Environment- Definition, scope, importance Natural Resources Forest resources- Use & over-exploitation, deforestation, timber extraction, mining, dams & their effects on forest & tribal people Water Resources, Mineral Resources, Food Resources, Energy, Land Resources Ecosystem- Concept, Structure & function, Producers, Consumers & decomposers. Energy flow in the ecosystem Ecological succession, Food chains, trophic levels, food webs & ecological pyramids. Evolution of ecosystem. Introduction, types, characteristics, features, structure & functions of – Forest ecosystem, Grassland ecosystem, Desert ecosystem & aquatic ecosystems- ponds, streams, lakes, rivers, oceans, estuaries	14 18
II	Definition, Causes, effects & control measures of – Air pollution, water pollution, land/ Soil pollution, Marine pollution, Noise pollution, thermal pollution, Nuclear Hazards, Bio indicators, Provision in the Indian Constitution and Environmental laws. Population Growth, Variation among nations Population explosion- Family Welfare programme, Environment & Human Health, Drug abuse, Human right. Value education, HIV/AIDS, Woman & Child Welfare Role of Information Technology in environment & human Health From unsustainable to sustainable development, Urban problems related to energy Climate Change- Global Warming, acid rain, Ozone layer depletion, nuclear accidents & holocaust Water Conservation, Rain Water harvesting, Watershed Management Environmental protection Act, Air (prevention & control of pollution) Act, Water (prevention & control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act	24

Text book:

- Environmental Studies by Gupta, K.M

Reference books:

- Foundation of Environmental Studies, Prof. Devendra S. Bhargava, Galgotia Publications Pvt. Ltd.
- Environmental Ecology, S. Deshwal & A. Deshwal, Dhanpat Rai & co.
- Environmental Studies, K.M. Gupta, Umesh publication.

Focus: This course focuses on Skill development aligned with CO2

Course outcomes: After completion of course, the student will be able to:
CO1- To understand fundamental concept of Environmental Sciences
CO2- Students will develop a sense of community responsibility by becoming aware of scientific issues in the larger social context

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

COs	POs/ PSOs
CO1	PO1, PO4, PO5, PO6/PSO2, PSO3
CO2	PO2, PO3, PO6, PO7/PSO1, PSO3

BSBO 0002: COMPUTER FUNDAMENTALS AND APPLICATIONS

OBJECTIVES: The objective of this course is that student with life science background will be familiar with basic knowledge of computers

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Characteristics, evolution, and generations of computer systems, Basic Computer Organization: Input, Output, Storage, Arithmetic Logic Unit, Control Unit, and Central Processing Unit **Number System**: Non-positional, Positional, Binary, Octal, and Hexadecimal, conversion from one number system to another **Computer Code:** BCD, EBCDIC, and ASCII **Computer Arithmetic:** Binary Addition, Subtraction, Multiplication, and Division **Processor and Memory:** The Central Processing Unit (CPU): Control Unit, ALU, Instruction Set, and Registers, Processor Speed, Main Memory, RAM, ROM,PROM, and EPROM, Cache Memory **Computer Software:** Relation between Hardware and Software, System, and Application Software, Logical System Architecture	18
II	**Computer Languages:** Machine, Assembly, and High-level Language, assembler, Compiler, Linker, and Interpreter (*in brief*), General overview of C **Operating System:** Functions, measuring system performance, Multiprograming, Multitasking and Multiprocessing, time sharing **Database Management System**: Introduction of Hierarchical, Network, Relational, and Object oriented **Computer Networks**: Topologies: Star, Ring, Completely connected, Multi-acces Bus, and Hybrid, Network Type: LAN, WAN, and MAN **The Internet:** Email, FTP, and WWW, Uses of Internet **Classification of Computers:** Notebook, PCs, Workstations, Mainframe, and Supercomputers	24

Text books:

- Sinha, P.K., Computer Fundamentals, BPB Publication, New Delhi Sixth Edition

Reference books:

- Jain Y.K. Elements of Computer Science, CBS Publishers and distributors, New Delhi
- Behrouz A. Forouzan and Richard F. Gilberg: "Computer Science- A structured Programming Approach using C", C Language learning, 2007

Focus: This course focuses on Skill development aligned with CO3

Course outcomes: After completion of course, the student will be able to
CO1- Familiar with the basic knowledge of computer.
CO2- Familiar with basic programming concepts.
CO3- Able to use M.S. Office (M.S. Word, M.S. Power point, M.S. Excel and M.S. Access) and Internet efficiently.

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

COs	**POs/ PSOs**
CO1	PO1, PO4, PO5, PO6/PSO2, PSO3
CO2	PO2, PO3, PO6, PO7/PSO1, PSO3
CO3	PO3, PO4, PO8/PSO3

BSBC 0803: BIOMOLECULES LAB

OBJECTIVES: The objectives of this paper is to well worse the students with basic fundamental practicals related to biomolecules

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• To carry out preparation of Chromic acid • To carry out preparation of Buffer: Acetate Buffer • To carry out qualitative analysis of Carbohydrates • To carry out qualitative analysis of Lipids • To carry out qualitative analysis of amino acids • To carry out qualitative analysis of Proteins • Determination of Blood Group • To estimate standard curve of ^{P}NP so as to measure the activity of enzyme Acid Phosphatase • To estimate the amount of enzyme Acid Phosphatase in unit/gram of potato tissue • To determine the value of Km & Vmax of an enzyme Acid Phosphatase	30

Focus: This course focuses on Skill development aligned with CO1 & CO2

Course outcomes: After completion of course, the student will be able to
CO1- Understand qualitative analysis of Biomolecules (Carbohydrates, Lipids, amino acids, proteins)
CO2- Understand enzyme assay system in order to get useful product

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

COs	POs/ PSOs
CO1	PO1, PO2, PO5, PO6/PSO2, PSO3
CO2	PO4, PO6, PO7/PSO1, PSO3

BSBC 0804: CHEMISTRY- II LAB

OBJECTIVES: Predict products of chemical reactions. Explain patterns of chemical reactions. Demonstrate common chemical laboratory techniques, chemical instrumentation and other appropriate technology. Demonstrate ability to work in a cooperative environment, understanding of safe laboratory practice.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Teaching Hours
I	**Inorganic :-** (1) Qualitative analysis of inorganic mixtures, containing not more than 4 (four) ionic species (excluding insoluble substances) Out of the following :- Pb^{2+}, Hg^{2+}, Hg_2^{2+}, Ag^{+}, Bi^{2+}, Cu^{2+} , Cd^{2+}, As^{3+}, Sn^{4+}, Sn^{2+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH_4^{+}, K^{+} , Co_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_2^{-}, CH_3 to O^{-}, F^{-}, CL^{-}, Br^{-}, I, NO_3^{-}, SO_4^{2-}, GO_4^{2-}, PO_4^{3-}, BO_3^{3-}. (2) Gravimetric estimation of Barium and SO_4^{2-} as $Baso_4$ ions. **Organic** :- (1) Purification of Organic Compounds by crystallization (from water and alcohol) and distillation. (2) Detection of functional groups in mono functional Organic compounds	30

Focus: This course focuses on Employability aligned with CO1 & CO2

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

CO1- Understand chemical function in terms of structure and analytical knowledge.

CO2- Students will be master in basic research skills.

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

COs	POs/ PSOs
CO1	PO1, PO4, PO5, PO6/PSO2, PSO3
CO2	PO2, PO3, PO5, PO7/PSO1, PSO3

BSBO 0802: COMPUTER APPLICATION IN BIOTECHNOLOGY LAB

OBJECTIVES: To offer high-grade, value-based programmer in the field of Computer Applications. To bridge the gap between industry and academia by framing curricula and syllabi based on industrial and societal needs

Credits: 2 **Semester II** **L–T–P: 0-0-3**

Module No.	Content	Lab Hours
I	**To study of various computer components** Hardware(Input Devices, Output devices), Software(System S/w, Application S/w),	30
	To study about Booting and shut down process & Windows XP BIOS, POST and Booting Process	
	To study Windows Desktop and Getting started with Windows XP Getting Started with windows and Setting of Desktop	
	To study MS Word Formatting Editing, Grammar and Spelling checking and other important Tools of MS Office.	
	To study MS PowerPoint Preparing Slides, multimedia effects and slide animation.	
	To study MS Excel Using Formula, calculating field value, generating charts and other important tools of MS Excel	
	To study C Programming concepts C data type, conditional statements and concept of looping a Loopig	
	To study about internet Browsing, Google Drive & Email.	

	Web browser, E-mail account creation, sending E-mails with attachments, E-mail account setting etc.	
I	**To study about various Web Site & Search Engine** Surfing different important web sites and searching content using Search engine	
	To study about Social networking sites Study about Social networking Sites Account creating, setting Privacy and chatting using different web applications.	

Focus: This course focuses on Skill development aligned with CO1 & CO2

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

CO1- Apply the knowledge of mathematics and computing fundamentals to various real life applications for any given requirement.

CO2- Design and develop applications to analyze and solve all computer science related problems.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO7/PSO1, PSO3
CO2	PO1, PO4, PO5, PO6/PSO2

BSBC 0006 : MOLECULAR BIOLOGY

OBJECTIVES: Course covers basic properties of cells, and gives insight into the controlling centre i.e., Nucleus. Course aims to equip students with knowledge of the regulatory element of the cell i.e., DNA its transcript i.e., RNA and protein biosynthesis as well as their interrelationship and regulation. From fundamental students are introduced to scientific literature on the molecular basis of the life and linking it to modern scientific research.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module	Contents	Hrs.
I	**Introduction to Molecular Biology:** Structure of DNA (ss/ ds/ triple helical/ Quadriplex), Chargaff's Rule, Melting temperature (Tm), C-value & C-value paradox, Genomic organization of prokaryotes & eukaryotes, Nucleosome model of chromatin structural organization. Structure of gene (Introns; Exons). Central Dogma of Molecular biology. **DNA replication**: Enzymes involved and mechanism of prokaryotic/ eukaryotic DNA replication. **DNA repair system:** Mismatch repair; Nucleotide excision repair. **DNA recombination:** Holliday model of recombination & its mechanism. **Transposons:** Classification, basic mechanism of transposition (Copy & Paste; Cut & Paste mechanism). **Transcription:** Prokaryotic and eukaryotic transcription. Regulation of Gene expression in Prokaryotes and Eukaryotes. Lac operon, Trp operon, RNA processing (Capping, Polyadenylation and Splicing). RNAi/ Si RNA.	18
II	**Translation:** Genetic code, Prokaryotic and Eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation. Post translation modification of proteins. Chaperons assisted protein folding. **Mutation:** Molecular mechanism of mutation, Mutagens, Site directed mutagenesis. Genome Sequencing (Sanger method, Maxam Gilbart Method and Automated DNA sequencing) application of sequence information for identification of defective genes. Molecular mapping of genome: physical maps, molecular mapping. Mini and Micro satellite DNA, molecular markers in genome analysis: RFLP, RAPD, VNTR and AFLP analysis. Molecular mapping in pedigree and disease analysis.	24

Text book:

- Cell Biology, Genetics, Molecular Biology by Verma, P.K

Reference books:

- Molecular biology of cell, by Alberts B. D. Lewis J. Raff M. Roberts K. and Watson.

- Gene, Vol. V, VI, VII, VIII and IX, Lewin B., Oxford University Press, Oxford.
- Molecular biology of the Gene by Watson J. Hopkins, Roberts Steitz &Weiner, Benjamin Cummings.
- Text Book of Molecular Biology by K. Sivrama Sastry G. Padmanabhan and C. Subramanyam: MacMillan, India.
- Cell and Molecular biology by G. Karp, John Willey & Sons, U.S.A.
- Principles of Genetics by P.D. Snustad, M.L. Smmons, J.B. & Jenkins, John Willey & Sons, U.S.A.
- Cell and Molecular biology, De Robertis and De Robertis by Saunders Publications

Focus: This course focuses on Employability, Skill development aligned with CO1 & CO2

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

CO1- Enhance the knowledge and understanding of students in cell and molecular biology making them aware of the complexity and harmony of a cell.

CO2- To form the basis of Recombinant DNA technology and boost student's skills in this budding field of scientific & industrial research towards its practical applications. (Std. placed in Nat. Res. Lab's; JNU; IARI; Mustard Res Ins; JALMA, etc.)

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO6/PSO2, PSO3
CO2	PO1, PO4, PO7, PO8/PSO1, PSO2

BSBC 0007: PLANT SCIENCE-I

OBJECTIVES: To study the morphology, taxonomy and physiology of Higher plants.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Anatomy:** Techniques for study of plant anatomy, Meristems, Leaf anatomy, Epidermis, Stomata, Origin, Structure and function of vascular cambium, Structure of xylem and phloem, Cork cambium activity and products, Root stem transition, **Taxonomy:** Systematic position, Distinguishing character and economic importance of the following families: Papaveraceae, Rutaceae, Apiaceae. Apocynaceae, Lamiaceae, Aselepiadaceae, Poaceae **Plant Water Relations:** Diffusion, Osmosis, Permeability, Imbibition, Plasmolysis, Osmotic potential, Water potential, DPD, Types of soil water, Mechanism of active and passive water absorption **Ascent of sap**: Definition, Theories of ascent of sap	14 18
II	**Transpiration:** Definition, Types, Stomatal apparatus, Stomatal periodicity, Mechanism of stomatal movements, Factors affecting stomatal movements, Factors affecting transpiration, Significance of transpiration, Wilting, Antitranspirants, Guttation **Mineral Nutrition:** Essential macro and micro elements and their role in plants (deficiency, symptoms, disease and functions), Mechanism of passive and active mineral salt absorption, Hydroponics, Mechanism of translocation of solutes (Mass flow or munch hypothesis, protoplasmic streaming theory) **Photosynthesis:** Introduction, Significance, Historical aspects, Photosynthetic pigments, Concept of two photosystems, Light phase: Cyclic and Non cyclic photophosphorylation (z scheme), Dark phase: Calvin cycle (C3), Hatch and slak cycle (C4) and CAM pathway, Photorespiration (C2 cycle), significance of Photosynthesis **Respiration:** Introduction, Types, RQ, Glycolysis, Kreb's cycle, Factors affecting respiration, Fermentation	24

Text book:

- Unified Botany 3rd Year by Agrawal, S.B
- Text book of Botany Diversity and Systematics by Singh, V

Reference books:

- Botany, Author: A.C.Dutta, Pub: oxford university press
- Elementary Biology, Author: Bhatia & Tyagi, Pub: trueman book company
- A Test Book of Plant Physiology, Biochemistry & Biotechnology, Author: Verma & Verma, Pub: S.chand
- Plant Physiology, Author: Salisbury & Ross, Pub: WADSWORTH Cengage learning
- Unified Botany, Author: Agrawal S.B, Pub: Shivlal Agrawal

Focus: This course focuses on Skill development aligned with CO1 & CO2

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

CO1- Identify the plants and their variation.

CO2- Understand how the metabolic activity takes place in plants and how they are regulated

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO6/PSO2, PSO3
CO2	PO1, PO2, PO7, PO8/PSO1, PSO3

BSBC 0008 : BIOCHEMISTRY

OBJECTIVES: To consolidate the student's training in Chemistry, Biology and other disciplines, as well as integrates the two to enhance a better understanding of biochemical principles.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Carbohydrate metabolism:** Embden-Meyerhof pathway , regulation of glycolysis, fermentation, anaerobic fate of pyruvate, pentose phosphate pathway, citric acid cycle, regulation of citric acid cycle, gluconeogenic pathway, control of gluconeogenesis, glycogen metabolism (glycogenolysis and glycogenesis), regulation of glycogen metabolism, electron transport chain system **Amino acids and protein metabolism:** essential aminoacids, nonessential aminoacids, glucogenic and ketogenic amino acids, amino acids biosynthesis (glutamate, glutamine, alanine, aspartate, asparagine serine, glycine, praline, cysteine, tyrosine), pathways of amino acids degradation (acetyl CoA family α- ketoglutarate family, succinyl CoA family), urea cycle	18
III	**Metabolism of Lipids and Nucleic acids:** fatty acid biosynthesis (fatty acid synthase complex, biosynthesis of long chain fatty acid, elongation of fatty acid chain, regulation), fatty acid oxidation (activation of fatty acids, role of carnitine in the transport of long chain fatty acid, β oxidation of saturated and unsaturated fatty acids, α and ω oxidation of fatty acids, regulation), biosynthesis of cholesterol, biosynthesis of purine and pyrimidine nucleotides, deoxyribonucleotides	24

Text book:

- Instant notes Biochemistry by Hames, David

Reference books:

- Principles of Biochemistry, Author: AlbertL. Lehninger, Pub: CBS
- Biochemistry, Author: Lubert Stryer, Pub: Freeman International Edition
- Fundamentals of Biochemistry, Author: J.L. Jain, Pub: S. Chand and Company
- Biochemistry, Author: Keshav Trehan, Pub: Wiley Eastern
- Principles of Biochemistry, Author: Jeffory Zubey

Focus: This course focuses on Employability aligned with CO1 & CO2

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

CO1- Students will be able to understand various anabolic & catabolic pathways related to carbohydrates, lipids, protein and nucleic acids

CO2- To understand basic metabolic pathway of the cell.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO6/PSO1, PSO3
CO2	PO2, PO3, PO7, PO8/PSO1, PSO2

BSBC: 0009 : STEM CELL TECHNOLOGY

OBJECTIVES: The programme offers excellent transferable skills for subsequent employment in biomedical and clinical research area. The students will also learn various ethical issues that concern the stem cell and tissue engineering research.

Credits: 02 **Semester III** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Stem Cells** Definition, Classification, Stem-cell plasticity, Differences between adult and embryonic stem cells. **Embryonic Stem Cells** Blastocyst and inner cell mass cells; Regulators of pluripotency and differentiation of stem cell; The isolation, expansion, genetic manipulation, genomic reprogramming, and cloning of stem cells. Stem cells cryopreservation. **Cloning and nuclear transfer Technology**: Human Therapeutic and Reproductive Cloning. Mammalian Nuclear Transfer Technology. Risks of cloning? The Cloning of Dolly and other Mammals, Patient-Specific Embryonic Stem Cells Derived from Human SCNT Blastocyst. Human Cloning and Human Dignity: An Ethical Inquiry **Ethics:** Controversy surrounding human embryonic stem cell research, societal implications: women, low-income, Different religious views, Current Ethical Guidelines in America, Ethical views of other countries and how this affects advancement of science Policy	18
II	**Regenerative medicine:** Overview of embryonic and adult stem cells for therapy Neurodegenerative diseases; Parkinson's, Alzheimer, Spinal Code Injuries and other brain Syndromes; Tissue system Failures; Diabetes; Cardiomyopathy; Kidny failure; Liver failure; Cancer; Hemophilia etc	24

Text book:

Robert Lanja, Essential of Stem Cell Biology, 2nd Edition, academic Press, 2006

Reference books:

- Ann A.Kiessling, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential,Jones and Bartett, 2003.
- Peter J.Quesenberry, Stem Cell Biology and Gene Therapy, 1st Edition, Willy-Less, 1998

- A.D.Ho., R.Hoffiman, Stem cell Transplantation Biology Processes Therapy, Willy-VCH, 2006
- C.S.Potten, stem Cells, Elsevier,2006

Focus: This course focuses on Entrepreneurship, Skill development aligned with CO1 & CO2

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

CO1- Explain how stem cells are derived for scientific research; compare and contrast tissue-specific stem cell types (e.g., blood, skin)

CO2- Understand basic mechanisms that regulate them; and extrapolate potential clinical use(s) of stem cells. The course content provides the necessary expertise to compete in an ever changing world.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7/PSO1, PSO3
CO2	PO1, PO3, PO7, PO8/PSO2, PSO3

BSBO 0003: BIO-INFORMATICS

OBJECTIVES: Bioinformatics is an interdisciplinary program offering substantial training in both the biological sciences and the physical and mathematical sciences; our program emphasizes the integration of computer science with genetics and molecular biology.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Bioinformatics & Biological Databases** Principles of DNA and Protein sequencing, File Formats for storage of Sequence and Structural Data, Primary Sequence Databases of Nucleic Acids and Proteins, Organism Specific Genome Databases, Structural Databases. Specialized Sequence Databases of Expressed Sequence Tags, Gene Expression, Single Nucleotide Polymorphism, OMIM, Unigene etc., Data Retrival with ENTERZ, SRS and DBGET, Secondary Databases (Pfam, PROSITE,PRINT, Block, etc.) **Algorithms & Tools** Sequence Alignment (Pair wise and Multiple), Alignment Algorithms, Database Similarity Searches (BLAST, FASTA AND psi-BLAST), Amino Acid Substitution Matrices (PAM, BLOSUM), Profiles and Motifs.	14 18
II	Protein Structure Prediction (Secondary and Tertiary),*ab intio*, Homology Modeling, Threading; ORF Prediction, Gene Prediction, Micro Array Data Analysis.**Applications of Bioinformatics in Biotechnology Research** PCR Primer designing, Structure Visualization Methods (SPD viewer,RasMol), Structure Classification(SCOP,CATH),Structural Alignment and Analysis(VAST), Bioinformatics Application in Drug target identifications, Computer aided Drug Designing and Computer aided Vaccine Designing	24

Text book:

- Bioinformatics: Concepts, Skills and Application by Rastogi, S.C

Reference books:

- B N Mishra, Bioinformatics: Concept and application, Pearson Education (in Press)
- O'Reilly: Developing Bioinformatics Computer Skill.
- Anthony JF Griffths et al: An intro to Genetic analysis.
- Michael Starkey and Ramnath Elaswarapu; Genomcis Protocols, Humana Press
- Stephen Misner & Stephen Krawetz Bioinformatics Methods and Protocols

- Lawrence Hunter – Artificial Intelligence & Mol. Biology, free on web
- Westhead P: Instant notes on Bioinformatics; Viva Publication
- Hooman H Rasidi Bioinformatics Basic Application in Biological Science and medicine; CRC Press.

Focus: This course focuses on Employability, Skill development aligned with CO1 & CO2

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

CO1- Complete these programs either enter the top graduate programs in bioinformatics and computational biology

CO2- Understand the value of bioinformatics tools.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7/PSO2, PSO3
CO2	PO1, PO3, PO4, PO6/PSO1, PSO3

BSBC 0805: MOLECULAR BIOLOGY LAB

OBJECTIVES: Provide hands on experiments in performing basic molecular biology techniques such as DNA isolation, gel electrophoresis

Credits: 02 **Semester III** **L–T–P : 0–0–3**

Module No.	Content	Lab Hours
I	• Isolation of DNA from Bacterial cell • Isolation of DNA from Plant cell • Isolation of Plasmid DNA • Isolation of RNA • Estimate the concentration & purity of DNA and RNA by Spectrophotometric method • Analysis of DNA by Agarose Gel Electrophoresis • To perform Restriction enzyme digestion	30

Focus: This course focuses on Skill development aligned with CO1 & CO2

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

CO1- Understand safe laboratory practices and

CO2- Perform basic molecular biology technique

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7/PSO2
CO2	PO1, PO2, PO3, PO4, PO6/PSO1, PSO3

BSBC 0806 : PLANT SCIENCE-I LAB

OBJECTIVES: Objective of this lab is to provide hands on training for plant physiology practical and taxonomy study by observation of plant external morphology and anatomy study by dissection of stem, root and leaf.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Teaching Hours
I	• To demonstrate Osmosis with the help of Potato Osmometer • To demonstrate the phenomenon of Plasmolysis • To demonstrate root pressure • To demonstrate that water moves up through the xylem of plant • To demonstrate the phenomenon of Diffusion • To demonstrate Transpiration phenomenon with belljar method • To demonstrate the Stomatal transpiration by using four leaves • To compare the Stomatal & Cuticular transpiration of leaves of different plants by Cobalt chloride method • To separate chlorophyll pigments by Paper & Column Chromatography • To show the effect of different wavelength of light the process of photosynthesis • To study the anatomy of dicot and monocot stem • To study the anatomy of dicot and monocot root • To study the anatomy of dicot and monocot leaf • To study the taxonomic character sticks of Vinca rosea • To study the taxonomic character sticks of Hibiscus rosasinensis • To study the taxonomic character sticks of Datura	30

Focus: This course focuses on Skill development aligned with CO1 & CO2

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

CO1- Identify the plants family, monocot and dicot anatomy

CO2- Understand the physiology of plants practically

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7/PSO3
CO2	PO2, PO3, PO4, PO6/PSO1, PSO2

BSBC 0807: BIOCHEMISTRY LAB

OBJECTIVES: To gain strong foundation and basic knowledge of biochemical methods and their application in biology. To have a greater understanding of the underlying theory of these methods and their practical applications in the laboratories.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Estimation of carbohydrate by Anthrone method • Estimation of DNA by Diphenylamine method • Estimation of RNA by Orcinol method • Estimation of protein by Biuret method • Estimation of protein by Folin- Lowry's method • Estimation of cholesterol in blood serum • Separation of amino acid by Paper Chromatography & determination of Rf values • Study the effect of temperature on the activity of enzyme Acid Phosphatase • Study the effect of pH on the activity of enzyme Acid Phosphatase • To perform agarose gel electrophoresis of given DNA sample	30

Focus: This course focuses on Employability, Skill development aligned with CO2 & CO3

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

CO1- Understand basic fundamental concept of metabolism

CO2- Describe the qualitative analysis of carbohydrates, lipids, protein and nucleic acid

CO3- Understand the quantitative analysis of carbohydrates, lipids, protein, nucleic acid and cholesterol.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7/PSO3
CO2	PO2, PO3, PO4, PO6/PSO1, PSO2
CO3	PO1, PO3, PO4, PO6, PO8/PSO2, PSO3

BSBO 0803 : BIO-INFORMATICS LAB

OBJECTIVES: To understand the use of bioinformatics tools freely available on internet. Focus on theory and practices of technique for analysis and manipulations of nucleic acids.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Sequence searching in NCBI using Enterz • BLAST Similarity searching for Qrthologous sequences • ORF Finder • Multiple Alignments using ClustalX • Web browser based Homology Modeling • Structural Visualization Software: RasMol, SPDViewer	30

Focus: This course focuses on Skill development aligned with CO1

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

CO1- To understand and applied different bioinformatics tools for the better outcomes.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO7/PSO2, PSO3

BSBC 0010: INSTRUMENTATION AND BIO-ANALYTICAL TECHNIQUES

OBJECTIVES: To develop skilled manpower in the field of Bioanalytical Sciences. The primary OBJECTIVES of this course are to develop the skills to understand the theory and practice of bio-analytical techniques.

Credits: 04 **Semester IV** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Concepts : Magnification and resolving power Simple light microscope Dark field microscope Phase contrast microscope Fluorescent microscope Electron microscope (SEM & TEM) pH meter Concept of Chromatography Paper chromatography & Thin layer chromatography Column Chromatography : Gel filtration, Ion exchange & Affinity chromatography	18
II	Native & SDS Poly acryl amide gel electrophoresis Isoelectric focusing 2 D gel electrophoresis Immuno electrophoresis Principle and laws of spectroscopy Colorimetry Spectrophotometry (Visible, UV infrared) . Atomic absorption spectroscopy . Nuclear Magnetic Resonance . Fluorimetry . Basic Principle of Centrifugation, Factors affecting Sedimentation velocity, Sedimentation Coefficient. . Types of centrifugation: Analytical, Differential, Rate-Zonal and sedimentation equilibrium Centrifugation.	24

Text book:

- Life Science in Tools & Techniques by P.S.Bisen & Shruti Mathur

Reference books:

- An introduction to Practical Biochemistry by T. Plummer
- Experimental Biochemistry by V. Deshpande and B. Sasidhar Rao
- Principle and Techniques in Biochemistryand Mol. Biology, Keth, Wilson and Walker

- Biophysical Chemistry Upadhyay & Nath
- Practical Microbiology by Aneja.
- Elements of Spectroscopy by Gupta, Kumar, Sharma (Pragati Prakashan)
- Introduction to Atomic spectra by H.E. White (McGrawHill Publication)
- Biological Instrumentation & Methodology by Bajpai, P.K
- Introductory Practical Biochemistry by S.K. Sawhney, Randhir Singh,

Focus: This course focuses on Skill development aligned with CO1

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

CO1- Understand the principles and application of various techniques like microscopy, electrophoresis, centrifugation and spectroscopy

CO2- An overview of the instruments used in isolation and separation of molecules will enable the students to understand all subjects of Biotechnology as these tools and techniques will be used there in.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7, PO8/PSO1, PSO3

BSBC0011: MICROBIOLOGY

OBJECTIVES: The objective of the course is to familiarize students with aspects, scopes and applications of microbiology.

Credits: 04 **Semester IV** **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours

I	• **History and Scope of Microbiology.**
	• **Classification of Bacteria**.
	• **Morphology and Anatomy of Bacteria**- Size, Shape and Arrangement of Bacterial Cell, Cell Wall, Cytoplasmic Membrane, Flagella, Spores, Fimbrae and Capsule, Mesosomes, Abnormal forms due to Defective Cell Wall.
	• **Sterilization-** Definition and Different Methods of Sterilization.
	  ◦ Physical Methods- Autoclave, Hot air oven, Laminar airflow, Seitz filters, Sintered glass filters and Membrane filters.
	  ◦ Chemical Methods: Alcohol, Aldehydes, Phenols, Halogens and Gaseous agents.
	  ◦ Radiation Methods: UV rays and Gamma rays.
	• **Culture Media for Cultivation of Bacteria and Their Types-** Basal, Enriched, Selective Cum Differential and Enrichment medium.
	• **Principles of Staining Techniques and Their Types-** Negative, Simple and Differential and Special Staining.
	• **Bacterial Nutrition and Reproduction.**
	• **Bacterial Growth –** Growth Curve, Factors Influencing Growth. Batch, Continuous, Synchronous Culture and Diauxic Growth.
	• **Bacterial Genetics-** Mutation, Gene Transfer Mechanism (Transformation, Conjugation, Transduction, Lytic and Lysogenic Cycle).
		18

II	• **Economic Importance of Bacteria.** • **Virus-** General Characteristics and Morphology of Viruses including Bacteriophages, Classification of Viruses. Viriods and Prions. • Multiplication of DNA and RNA Viruses including Bacterial Viruses (Bacteriophages). • **Bacterial diseases and their control-** Tuberculosis, Tetanus, Typhoid and Food poisoning Bacteria (*Salmonella*). • **Viral diseases and their control-** Rabies, Hepatitis and HIV infection.	24

	• **Fungal diseases and their control-** Candidiosis and Sporotrichosis. • **Protozoan diseases and their control-** Malaria and Sleeping Sickness. • Antibacterial and Antifungal Agents.	

Text book:

- A Text Book of Microbiology by Dubey, R.C

Reference books:

- Microbiology, Authors- Pelczar, Chan and Kreig.
- Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case, C.L.
- General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter.
- Microbial Physiology, Authors- Moat and Foster.
- A Text book of Microbiology, Authors- P. Chakraborty.
- Textbook of Microbiology, Authors- Dubey and Maheshwari.
- Microbiology, A Practical Approach. Authors- Patel and Phanse
- General Microbiology, Authors- Powar and Daginawala.
- Microbiology, Author- S.S. Purohit.
- Microbiology, Authors- Presscott, Herley and Klein.
- Bacteriology, Authors- Topley and Wilson.

Focus: This course focuses on Employability, Skill development aligned with All COs

Course outcomes: After completion of this course, students will able to

CO1- Identify, culture and purify different microbial strains.
CO2- Prepare and sterilize different bacterial and fungal mediums with preparation and staining of smears.
CO3- Gain a deep knowledge regarding to various diseases their causative agents, diseases cycle, laboratory protocols for detection and finally the methods of control and presentation of diseases.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7/PSO2, PSO3
CO2	PO2, PO3, PO4, PO6/PSO1, PSO2
CO3	PO1, PO3, PO4, PO6, PO8/PSO2, PSO3

BSBC 0012: IMMUNOLOGY

OBJECTIVES: The students will be introduced to the basic concepts of immunology as it relates to human and animal health. The course is designed for students with knowledge of immunology and defense mechanism against invading agents and non-self-agents.

Credits: 04 **Semester IV** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• **History and Overview of Immunology** • **Immunity:** Introduction, Innate Immunity –Definition, Anatomical ,Physiological and Cellular barriers, Mechanisms (Phagocytosis,Inflammation,Complement Activation, Fever and Interferon), Ubiquity of Innate Immunity,Adaptive Immunity – Definition, Types, Differences between Innate and Adaptive Immunity, Cooperation between Innate and Adaptive Immunity, Characteristic Attributes, Types of Immune Responses in Adaptive Immunity. • **Antigens :** Definition of Antigen/Immunogen and Hapten, Factors influencing Antigenicity, Types of Antigens, Epitopes/ Antigenic Determinants, Cell Surface Receptors for antigens, Antigen Recognition Molecules • **Cells and Organs of the Immune system:** Hematopoietic stem cell, Haematopiesis, Cells of immune system (B Lymphocytes, T Lymphocytes. Macrophages, Null Cell, Mast Cells, Dendritic cell), Organs of the immune system Central Lymphoid Organs and Peripheral Lymphoid Organs • **Immunoglobulins (Antibodies) –** Definition, Basic structure, General Functions, Immunoglobulin Classes , Physicochemical and Biological Characteristics, Antigenic Determinants on Immunoglobulin (Isotype ,Allotype and Idiotype),Monoclonal Antibodies and their Applications, Theories of Antibodies Formation.	18
II	• **Antigen-Antibody Interactions and Serological Tests –** Characteristics of Antigen- Antibody Interactions,Physico-chemical Forces Involved in Ag-Ab interactions, Sensitivity and Specificity , Factors Influencing Antigen – Antibody Interactions, Cross Reactivity, Adjuvant , Examples , Importance and Mode of Actions, Serological Tests and their Applications:-, Agglutination test , Precipitation tests, Immuno Diffusion and Immunoelectrophoresis, RadioImmuno Assay (RIA), Enzyme L:nked Immunosorbent Assay (ELISA) ,Chemiluminence,Immunofluorescence and Complement Fixation Tests • **Immune Responses and Role in Infectious Diseases –Types of Immune responses:** Humoral Immune Response ,Primary and	24

	secondary Response, Cell Mediated Immune Response, Scope of CMI, Mechanism of Humoral and Cell Mediated immune Responses, Major Histocompatiblity Complex(MHC) and Role of MHC molecules in CMI, Immune Responses against Bacterial, Viral , Fungal and Parasitic Infections, Auto Immunity and Immunotolerence. • **Immunoregulatory Molecules and Immunomodulation** • **Hypersensitivity and Allergy** – Definition, Classification, Distinguishing Features of Immediate and Delayed Hypersensitivity IgE Mediated Hypersensitivity (Type I), Method used for Detection, Anaphylactic Reaction. Antibody Mediated Cytotoxicity (Type II) Hyper Sensitivity, Mechanism and Examples Immune Complex (Type III) Hypersensitivity: Localized and Generalized Type III Reactions, Mechanism Anybody Mediated Cell Stimulation (Type V) Hypersensitivity . Mechanism Delayed (Type IV) Hypersensitivity Me chanism and Important Aspect in Diagnosis of Diseases • **Vaccines and Toxoids** o Inactivated and Live Attenuated Vaccines o Sub unit Vaccines o Conjugate Vaccines o Recombinant Vector Vaccines o DNA Vaccines o Toxoids	

Text book:

- Immunology by Shetty, N

Reference books:

- Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
- Immunology by C. Fatima
- Immunology by Kuby (Free man publication)
- Essentials of immunology by Roitt (Blackwell scientific publication)
- Immunology by Benacera
- Infection & Immunity by John Playfair & Gregory Bancroft (Oxford university Press)

Focus: This course focuses on Employability aligned with CO2

Course outcome: After completion of this course, students will able to

CO1- Know the strength and weakness of our immune system and should it fail what the consequences are.
CO2- Understand the techniques for the formation of different types of Vaccines and Toxoids

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

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7, PO8/PSO1, PSO3

BSBC 0013 : DRUG DISCOVERY & DEVELOPMENT

OBJECTIVES: The objective of this course is to introduce students the basic process of drug discovery and various considerations to bring drug in market place

Credits: 02 **Semester IV** **L–T–P: 2-0-0**

Module No.	Content	Teaching Hours
I	Process of Drug Discovery: reductionist target-based approach, Target identification and validation, lead identification: High through-put screening, lead optimization and prioritization: ADME-TOX properties New strategies in drug discovery: Structure based drug designing, Molecular docking,	10
II	Computer aided drug designing, chemi-informatics etc Process of Drug Development: considerations and strategies, cost estimates, factors for choosing candidates for drug development, preclinical studies (cell-based and animal studies), clinical studies (Phase 1, 2, 3)	14

Text book:

- Drug Discovery & Development: Traditional Medicine and Ethnopharmacology By Bhushan Patwardhan

Reference book:

- Drug Discovery and Development: Technology in Transition By Raymond G Hill

Focus: This course focuses on Entrepreneurship, Skill development aligned with All COs

Course outcome: After completion of this course, students will able to

CO1- Understand of drug discovery pipeline and its connection with life science
CO2- Understand computer aided drug designing and process of drug development

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO5, PO7, PO8/PSO2, PSO3

BSBO 0004 : CLINICAL MICROBIOLOGY

OBJECTIVES: To familiarize students with various techniques and their applications in diagonosis of diseases through clinical microbiology.

Credits: 04 **Semester IV** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Overview and application of clinical microbiology. • Types, collection methods and transport of clinical specimens. • Direct examination of specimens. • The Bacteriology Section • The Mycology Section • The Parasitology Section	18
II	• The Virology/Sexually Transmitted Diseases (STD) Section • ***The Mycobacteriology Section*** Antimicrobial Assays – Bioassays, Liquid chromatographic Assays. • Bactericidal Tests – Minimal Bactericidal Concentration (MBC), Serum Antibacterial Titer (STT) and Serum Bactericidal Titer (SBT)	24

Text book:

- Henry's Clinical Diagnosis and Management by Laboratory Methods. 23 Edition.

Reference books:

- Laboratory procedures in clinical microbiology. 2nd Edition. By John A. Washington.
- Clinical Microbiology Made Ridiculously Simple. 5th Edition. Mark Gladwin, Bill Trattler. Publisher Medmaster.

Focus: This course focuses on Employability, Skill development aligned with All COs

Course outcomes: After completion of this course, students will able to

CO1- Understand contribution of microbes in infectious diseases.

CO2- Collect and handle various clinical specimens with knowledge of antimicrobial assay.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO5, PO7, PO8/PSO2, PSO3
CO2	PO1, PO3, PO5, PO6, PO7, PO8/PSO1, PSO3

BSBC 0808: INSTRUMENTATION AND BIO- ANALYTICAL TECHNIQUES LAB

OBJECTIVES: To provide the students with a comprehensive overview of current developments in bioanalytical techniques.

Credits: 02 **Semester IV** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Microscopy – Light microscopy : principles, parts & function, Operation • Calibration of Micropipette, pH Meter and Electronic Balance • Buffer preparation with the help of pH meter • Separation of chlorophyll pigment by Paper Chromatography • Separation of mixture of Sugars/ Amino acids/ Plants pigments by Thin Layer Chromatography • Demonstration of Immuno electrophoresis • Demonstration of SDS-PAGE. • Separation of Nucleic acid by Agarose gel electrophoresis. • Estimation of protein in given sample by colorimeter/ spectrophotometer • Principle & operation of Centrifuge • To carry out qualitative test for Amylase, Invertase, Pepsin enzymes. • RBC & WBC count by Haemocytometer in blood • To carry out qualitative test for sugars, protein, lipids • Prepares Slides: Historical slides of mammals of following organs- Stomach, Intestine, Liver, Pancreas, Kidney, Testis, Ovary and Spinal cord • Embryological Slides: Whole mount of chick embryo showing primitive streak, Whole mount of 5, 10, 20, and 48 somites stage of embryo • Microscopic study of different tissues. • Estimationof haemoglobin in blood, Determination of bleeding time, clotting time. • Recording of body temperature, pulse rate and blood pressure, basic understanding of Electrocardiogram – PQRST waves and their significance.	30

Focus: This course focuses on Employability, Skill development aligned with CO1 & CO2

Course outcome: After completion of this course, student will able to

CO1- Understand various techniques like microscopy, electrophoresis and chromatography in related experiments.

CO2- Understand the microscopical study of different tissues

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO5, PO7, PO8/PSO1, PSO2

BSBC0809: MICROBIOLOGY LAB

OBJECTIVES: The main objective of this course is to well verse the students with practical knowledge of Microbiology that they have taught in the theory and provide hands on training on practical techniques of Microbiology related practical.

Credits: 02 **Semester IV** **L–T–P: 0–0–3**

Module No.	Contents	Lab Hours
I	• To study basic rules and safety measures in microbiology laboratory. • To study different methods of cleaning of glass wares used in microbiology laboratory. • To study the working of different types of Instruments used in microbiology laboratory. • To prepare cotton plugs for conducting microbiological experiments. • Demonstration of bacteria in water, soil, air, skin and working table tops. • To perform Negative staining of given bacterial culture. • To perform Simple staining for the study of bacterial morphology. • To perform Gram's staining to differentiate Gram positive and Gram negative bacteria. • To perform Acid- Fast staining to differentiate Acid-Fast and Non Acid- Fast bacteria. • To perform Capsule staining of given bacterial culture. • To prepare Nutrient Agar, Nutrient Broth, Blood Agar and Mac-Conkey Agar Medium for the routine cultivation of bacteria. • To prepare Potato Dextrose Agar, Sabouraud Agar and Martin's Rose Bengal Agar Medium for the routine cultivation of fungi. • To Study different methods of obtaining pure culture of microorganisms. • To isolate and enumerate bacterial colonies from soil samples. • Isolation and enumeration of fungi from soil. • To perform in-vitro antibiotic sensitivity test against specific bacterial cultures.	30

Focus: This course focuses on Employability, Skill development aligned with all COs

Course outcomes: After completion of this course, students will able to

CO1- Culture, isolate and purify microbes from various sites.

CO2- Observe the morphology of microbes by using different staining techniques.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO6, PO7, PO8/PSO2, PSO3
CO2	PO2, PO3, PO4, PO5, PO7, PO8/PSO1, PSO3

BSBC 0810: IMMUNOLOGY LAB

OBJECTIVES: To well verse the students with practical knowledge of Immunology and its application that they have taught in the theory and to provide hands on training.

Credits: 02 **Semester IV** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Various routes of inculcation in Laboratory animal • Preparation of Somatic antigen • Raising of Antiserum in Laboratory animal • Quantization of total serum Immunoglobulin by $ZnSO_4$ turbidity test • Bacterial slide agglutination test • Determination of Blood Groups in Human • Tube Agglutination Test • Ochterlony Immuno diffusion test • Erythrocyte rosette formation by T lymphocyte • Rocket Electrophoresis • ELISA Test	30

Focus: This course focuses on Employability, Skill development aligned with All COs

Course outcomes: After completion of this course, students will able to

CO1- Handle the laboratory animals

CO2- Perform various serological tests which finally enhance the ability to understand related theory.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO5, PO6, PO7, PO8/PSO1, PSO3
CO2	PO2, PO3, PO4, PO5, PO7, PO8/PSO1, PSO2

BSBO 0804 : CLINICAL MICROBIOLOGY LAB

OBJECTIVES: This course aims to impart in students an understanding of clinical microbiology and contribution of microbes in infectious diseases.

Credits: 02 **Semester IV** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Safety measures in clinical microbiology lab • Collection of various clinical specimens. • Isolation of bacterial strains from clinical specimens. • Isolation of fungal strains from clinical specimens. • Bactericidal Tests – Minimal Bactericidal Concentration (MBC). • Antimicrobial susceptibility assays.	30

Focus: This course focuses on Employability, Skill development aligned with All COs

Course outcome: After completion of this course, students will able to

CO1- Collect and handle various clinical specimens with knowledge of antimicrobial assay.
CO2- Understand safety measures in clinical microbiology lab

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

COs	POs/ PSOs
CO1	PO1, PO2, PO5, PO6, PO7, PO8/PSO1, PSO3

BSBC 0014: PLANT BIOTECHNOLOGY

OBJECTIVES: To provide knowledge of different techniques for the utilization of Plant material for the production of valuable products as well as provide the idea how plant can be useful for the human welfare.

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Introduction to cell tissue culture, tissue culture as a technique to produce novel plants and hybrids: Tissue culture media (composition and preparation). Initiation and maintenance of callus and suspension culture; single cell clones. Organogenesis: Anther, pollen and ovary culture for production of haploid plants and homozygous lines.somatic embryogenesis, artificial seeds, Shoot-tip culture: rapid clonal propagation and production of virus –free plants. Embryo culture and embryo rescue Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants, cybrids. Basic Techniques in r-DNA Technology for Plant transformation : Ti and Ri plasmids, mechanisms of DNA transfer role of virulence genes, use of Ti and Ri as Vectors,	18
II	Binary vectors , use of 35S and other promoters, genetic markers, Reporter genes, reporter gene with introns, viral vectors and their applications, Vector less or direct DNA transfer (particle bombardment, electroporation, microinjection). Single cell suspension culture, Plant secondary metabolites, therapeutic proteins, and edible vaccines.Application of plant transformation for productivity and performance :Transgenuc Plants resistance to herbicides (phosphinotricin , glyphosphate , sulphonylurea , atrazine);insect(Bt genes) , non Bt like protease inhibitors, alpha amylase inhibitors , virus resistance , coat protein mediated, nucleocapsid gene, disease resistance , chitinases,1-3 beat glucanase, abiotic stress (salinity , drought) , post harvest losses, long shelf life of fruits and flowers, use of ACC synthase (1-aminocyclopropane-1-carboxylate synthase) polygalactouranase, ACC oxidase, male sterile lines , bar and barnase systems, carbohydrate composition and storage , ADP glucose pyrophophatase.	24

Text book:

Biotechnology by B.D.Singh (Kalyani Publishers)

Reference books:

- Plant Tissue Culture: Application and Limitations. Bhowjwani, S.S. 1990.
- Plant Cell Culture: A practical approach. Dixon. 1994.

- Plant Cell Culture, Advances in Biochemical Engineering and Biotechnology. Anderson, L.A.,
- Biochemistry & Molecular Biology of Plants. Kosuge. 1983
- Biochemistry & Molecular Biology of Plants, Buchnan, Gruissen Jones, I.K. International Pvt. Ltd., 2004.
- Plant Biotechnology, Ashwani Kumar, Shikha Rohy, I.K. International Pvt. Ltd, 2006.
- Plant Taxonomy, O.P. Sharma, TMH Publication, 2006.
- Biotechnology by B.D.Singh (Kalyani Publishers)
- Text book of Biotechnology by R.C.Dubey (S.Chand and company

Focus: This course focuses on employability aligned with All COs

Course outcomes: After completion of this course, student will able to

CO1- Utilize their knowledge of plant biotechnology in the crop quality improvement, production of secondary metabolites,

CO2- Know how the plant can be in vitro cultured by plant tissue culture and utilize them for commercial application.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO5, PO6, PO7, PO8/PSO1, PSO3
CO2	PO2, PO3, PO5, PO6, PO8/PSO2, PSO3

BSBC 0015 : RECOMBINANT DNA TECHNOLOGY

OBJECTIVES: To expose students with recent advances in the field of Recombinant DNA Technology and their implication in life sciences research.

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Vectors** Gene Cloning -Concept and Basic Steps; Cloning Vectors: Plasmid Cloning Vector pBR322,pUC19,Vectors for Cloning large piece of DNA; –Bacteriophage-λ and other phage vectors; Cosmids, Phagemids; YAC and BAC vectors **Tools & Techniques** Enzymes used in Recombinant DNA Technology Endonucleases, Ligases and other Enzymes useful in Gene Cloning, PCR technology for Gene/DNA Detection,Cloning of Foreign Genes: Transferring DNA into *E. coli* –Chemical induction and Electroporation,	18
II	Gene library: Construction of cDNA library and Genomic Library, Screening of Gene Libraries – screening by DNA Hybridization, Immunological Assay and Protein Activity, Marker Genes: Selectable Markers and Screenable Markers Gene Expression in Prokaryotes: Strong and Regulatable Promoters; Increasing Protein Production; Fusion Proteins; Translation Expression Vectors; DNA Integration into Bacterial Genome; Increasing Secretions; Metabolic Load, Recombinant Protein Production in Yeast: *Saccharomyces cerevisiae* Expression Systems; Mammalian Cell Expression Vectors Gene Therapy for diseases (AIDS, Cystic Fibrosis and Parkinson), Applications of Recombinant DNA Technology	24

Text book:

- Biotechnology by B.D.Singh (Kalyani Publishers)

Reference books:

- DNA cloning 1 and 2. Glover, D.M. and Hames, B.D. IRL Press (Oxford University Press, USA).
- Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis. Cold b Spring Harbor Laboratory, USA.
- Recombinant DNA. Watson.
- Molecular Biology of the Cell. Alberts, Johnson, Lewis, Raff, Roberts and Walter.
- Advanced Genetics, G.S. Miglani, Narosa Publishing House.

- DNA Science, David A. Micklos, Grog. A Freyer, I.K. International Pvt. Ltd.
- Frontiers in Plant Science, K.G. Mukerji etal, I.K. International Pvt. Ltd.
- Schaum's - Molecular & Cell Biology, Gregory B. Ralston,William D. Stan's field, TMH Publication.
- Schaum's – Genetics, Susan Elrod, William Stan's field, TMH Publication.
- Principle of Genetics, Robert H. Tamarin, TMH Publication.
- Genetics, C. Sarin, TMH Publication.

Focus: This course focuses on Employability, Skill development aligned with All COs

Course outcomes: After completion of this course, students will able to

CO1-Acquaint theoretical understanding of genetic engineering tools and techniques, i.e. restriction digestion, blotting, map-based cloning, PCR etc.

CO2- Understand concept of gene therapy and applications of recombinant DNA technology

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

COs	POs/ PSOs
CO1	PO1, PO2, PO5, PO6, PO7, PO8/PSO1, PSO3

BSBE 0004: CHEMISTRY- III

OBJECTIVES: Impart sufficient qualitative/quantitative analytical and synthetic chemical knowledge and skills to students. Impart a disciplined approach to conceptualizing chemical problems in numerical terms .Predict products of chemical reactions.Explain patterns of chemical reactions.

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Chemistry in daily life:-** chemicals in medicine and health care, chemicals in food, Dyes, chemistry of rocket propellants **Pesticides** General introduction to pesticides (natural and synthetic), benefits and adverse effects, synthesis and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion,Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil) ,Anilides (Alachlor and Butachlor). **Nanochemistry:-** Introduction to nanochemistry	18
II	**Electro Chemistry ,**Galvanic Cells, Electro chemical cells, electrical energy and the EMF, electrical energy galvanic cells, Reversible and irreversible cell, Notations used in Cell diagrams, Reversible electrodes, Measurement of EMF, Weston standard cell, electrode potential, measurement of electrode potential. Electrode Potential and Equilibrium constant liquid junction potential, concentration cells, application of concentration cells. **Thermodynamics – I** Definitions of thermodynamic terms :- System, Surrounding etc. Types of Systems intensive and extensive properties. State and path functions and their differentiates Thermodynamic process, concept of heat & work. First Law of thermodynamics : Statement, definition of internal energy and enthalpy Heat capacity, Heat capacities at constant volume and pressure and their relationship. Joule's Law : Joule – Thonson Coeffeciant and Inversion temperature. Calculation of W1 q dU and dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.	24

Text book:

- M.M.N. Tandon, "Unified Chemistry for B.Sc. Second Year": Shivlal Agarwal & Co.,2016

Reference books:

- S.Glasstone, "Textbook of Physical Chemistry": D. Van Nostrand Co., Princeton, NJ ,1961
- R.D.Madan, "Modern Inorganic Chemistry": S. Chand Publishing, 2019
- I.L. Finar, "Organic Chemistry Vol. 1":Pearson, 2002

Focus: This course focuses on employability aligned with CO2 & CO3

Course outcomes: After completion of course, the students will be able to

CO1-Understand chemical function in terms of daily life, thermodynamics, and electrochemistry.

CO2- Understand the chemistry of pesticides and their applications.

CO3- Understand the importance of nanochemistry, how it came to be, and its role in daily life applications.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO6, PO7, PO8/PSO1, PSO3
CO2	PO1, PO2, PO5, PO7, PO8/PSO2, PSO3
CO3	PO1, PO4, PO5, PO6, PO7, PO8/PSO1, PSO2

BSBE 0005: GENETICS

OBJECTIVES: The objective of this course is to understand the Mendelian and non-mendelian modes of inheritance that govern passage of genetic traits across generation, to use this knowledge of inheritance to track alleles through generations and categorize and predict genotypes and phenotypes, to understand different mechanism of sex determination, basic principles of population genetics and classical and modern concept of genes.

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Genetics** **Mendelian Laws of Inheritance** **Interaction of Genes:** Supplementary Genes (comb pattern in fowls), Complementary Genes (flowers pattern in sweat peas), Epistasis (fruit colour in Cucurbita pepo and pigmentation in onion bulb), Multiple factors (skin colour in human beings), Incomplete Dominance (flower colour in Mirabilis japla), Codominance (coat colour in short horned cattle), Multiple allelism (blood groups in human beings), Pleiotropy (sickle cell anaemia) **Linkage:** Definition, coupling and repulsion hypothesis, linkage in Drosophila, linkage groups, factors affecting linkage **Crossing over:** Definition, mechanism of crossing over, significance, crossing over in Drosophila, factors affecting crossing over **Chromosome Map:** chromosome maps in Drosophila and maize, Interference, Coincidence **Sex Determination:** chromosomal mechanism (XX-XY, XX-XO, ZO-ZZ and ZW-ZZ), male haploidy and haplodiploidy mechanism, genic balance theory, cytoplasmic sex determination, sex determination in melandrium, sphaerocarpus and higher plants (XX-XY, ZZ-ZW, XX-XO), Non disjunction as a proof of chromosomal theory of sex determination	18
II	Sex linkage, types of sex linked genes, inheritance of sex linked characters (colour blindness,haemophilia), inheritance of eye colour in Drosophila, criss cross inheritance, holandric genes **Hereditary defects:** Klinefelter's syndrome, Turner's syndrome, Down's syndrome, Edward's syndrome, Patau's syndrome, cri du chat syndrome **Concept of Genes:** classical and modern gene concept, pseudoallelism, position effect **Chromosomal aberrations:** structural changes (deletion, duplication, inversion and translocation), numerical changes (aneuploidy, euploidy, haploidy, polyploidy), Mutagens	24

	Cytoplasmic inheritance: Definition, plasmagenes, kappa particles in paramecium, shell coiling in snail, plastid inheritance in Mirabilis jalapa **Population Genetics:** gene pool, gene frequency, Hardy-Weinberg law, significance, applications of Hardy-Weinberg law	

Text book:

- Cell Biology, Genetics, Molecular Biology by Verma, P.K

Reference books:

- Principles of Genetics, Author: Gardner E.J & Snustad D.P, Pub: john Wiley
- Principles of Genetics, Author: Snustad D.P, Simmons M.J, Pub: john Wiley
- Genetics A molecular approach, Author: Brown T.A, Pub: BIOS Scientific
- Fundamentals of Genetics, Author: Singh B.D, Pub: Kalyani
- Genetics, Author: Rastogi V.B, Pub: Kedar Nath Ram Nath
- Genetics, Author: Verma P.S & Aggarwal V.K, Pub: S.Chand
- Principles of Gene Manipulations, Author: Old & Primose, Pub: Black Well Scientific
- Genes, Author: Lewine B, Pub: Oxford University Press, London

Focus: This course focuses on employability aligned with CO2 & CO3

Course outcomes: The main outcomes of this course are:

CO1- Comprehensive, detailed understanding of the chemical basis of heredity
CO2- Comprehensive and detailed understanding of genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.
CO3- Understanding of how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc.
CO4- Understanding the role of genetic mechanisms in evolution.

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

COs	POs/ PSOs
CO1	PO1, PO4, PO5, PO6, PO7, PO8/PSO1, PSO2
CO2	PO2, PO4, PO5, PO7, PO8/PSO2, PSO3
CO3	PO2, PO3, PO5, PO6, PO7, PO8/PSO1, PSO3
CO4	PO1, PO3, PO5, PO7, PO8/PSO2

BSBE 0006: PLANT SCIENCE- II

OBJECTIVES: The objective of the course is to help students attain a basic proficiency in the area of plant research, which includes plant breeding and impact of various etiological agents.

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Microsporophyll, Structure of anther; microsporogenesis and structure of microspore and development of the male gametophyte. Megasporophyll, Structure of ovule (megasporengium), types of Ovules, megasporogenesis and development of the female gametophyte with particular reference to polygonum type. Megagametogenesis, Fertilization,double fertilization, enmbroyogeny and endosperm Apomixis and polyembryony. Characteristics of fungal, bacterial & viral disease& their control measures Systematic position, morphology of etiological agent, Host- parasite relationship, disease cycle in the following diseases - White Rust of crucifers, Late blight of potato, Loose smut of wheat, Rust of wheat, Citrus canker and Yellow vein disease of Bhindi.	14
II	Nature and OBJECTIVES of plant breeding. General methods of plant breeding.,Role of hybrid vigour in plant breeding. Economic importance with special reference to plant yielding: a) Food: Cereals (Rice, Wheat, Maize) Potato, sugarcane, legumes (Pigeon pea, gram and pea): Oil yielding plants (Sarson, Til, Ground Nut, Cotton).Fruits (Apple, Peach and Citrus). b) Common fiber yielding plants cotton, Sunhemp, Jute and Coir. c) Medicinal plants (Paper sominiferrum, Rauwolfia serpentina and Atropa beladona). Common timber yielding plants- Pinus,Cedrus Deodara, Shorea robusta, Dalbergia	14

Text book: A Text Book of Botany Structure Development & Reproduction in Angiosperm by Singh, V

Reference books:

- Singh, Pande-Jain, A Text Book of Botany,Rastogi Publication
- R.S. Mehrotra, Plant Pathology, Tata McGraw-Hill Publishing Company Ltd.
- Dutta A.C. A Class of Botany, Oxford University Press.

Focus: This course focuses on employability aligned with CO2

Course outcomes: After completion of this course, students will able to

CO1-Understand fertilization in flowering plants, details of various etiological agents such as bacteria, fungus & viruses with nature,

CO2- Know the objectives and economic importance of plant breeding with examples.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO2

BSBE 0007: FOOD AND INDUSTRIAL BIOTECHNOLOGY

OBJECTIVES: The objective of the course is to help students attain a basic proficiency, role and application of biotechnology in the area of food and industrial processes.

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• History and Overview of Food and Industrial Microbiology. • **Contribution of Microorganisms in Food Microbiology-** Bacteria, Yeast and Moulds. • Principles of Microbial Growth, Factors Influencing Microbial Growth in Food. • **The Bioreactor/Fermenter-** Types and Parts, Scale-up, Media Design for Fermentation Processes. • Production of Microbial Enzymes and Their Applications in Industries, Immobilized Enzymes. • **Principles underlying Food Spoilage and Contamination-** Canned Food, Sugar Products, Fruits, V vegetables, Meat and Poultry. • **Bacterial Food Borne Infections and Intoxications-** *Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus* and *Vibrio* • Microbial Metabolism and Its Impacts on the Production of Various Metabolites of Industrial Importance. • **Alcoholic Beverages** – Beer and Wine.	18
II	• **Organic acids** – Citric Acid and Lactic Acid. • **Antibiotics** – Penicillin and Streptomycin. • **Amino acids** – Glutamic acid. • **Vitamins** – B12**Principles of Food Preservation** – Asepsis, Removal of Microorganisms, Anaerobic Conditions, High and Low Temperature, Drying. • Chemical Preservatives and Food Additives. • **Food Fermentation and Food Produced by Microbes-** Bread, Cheese, Vinegar,Youghart, Coffee and Pickles. • Oriental Fermented Foods. • Microbial Cells as Food- Single Cell Protein, Mushroom Cultivation.	24

Text book:

- Biotechnology by Dubey, R.C

Reference books:

- Frazier, W.S. and Weshoff, D.C., Food Microbiology by McGraw Hill Book Co., New York.
- Mann & Trusswell, Essentials of human nutrition by oxford university press.
- Jay, J.M., Modern Food Microbiology, CBS Publications, New Delhi.
- Lindsay, Applied Science Biotechnology. Challenges for the flavour and Food Industry, Willis Elsevier.
- Roger, A., Gordon, B. and John, T., Food Biotechnology.

Focus: This course focuses on employability, skill development aligned with All COs

Course outcomes: After completion of this course, student will able to

CO1- Understand contribution of microbes in food industry.

CO2- Understand positive and negative impact of various microbes in terms of "fermentation, microbial metabolism"

CO3- Understand "principles underlying food spoilage and contamination, various food born infections and intoxications" respectively.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO2
CO2	PO3, PO4, PO6, PO7, PO8/PSO1, PSO2
CO3	PO2, PO3, PO4, PO5, PO7, PO8/PSO3

BSBE 0008: ENZYMOLOGY

OBJECTIVES: The objective of this course is to well versed students with basic concepts of Enzyme technology

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Classification and Nomenclature of enzymes • Isoenzymes and Multienzyme complexes • Enzyme Inhibition: Reversible (competitive, non-competitive & uncompetitive) and Irreversible • Isolation and Purification of enzymes	18
II	• Enzyme Kinetics-Michaelis-Menton equation • Effect of temperature, pH, substrate concentration, product concentration, coenzyme concentration • Regulation of enzyme activity • Medicinal applications of enzymes • Industrial application of enzymes • Enzymes as an analytes	24

Text book:

- Enzyme Technology by S. Shanmugam & T. Satishkumar, Pub: I.K.International

Reference book:

- Understanding Enzymes by T.Palmer, Pub: Ellis Horwood Limited
- Fundamentals of Enzymology by Nicholas C. Price & Lewis Stevens, Pub: Oxford University Press

Focus: This course focuses on employability aligned with CO1

Course outcomes: After completion of this course, students will able to

CO1- Understand practical applications of enzymology in term of enzyme isolation, purification techniques and Enzyme kinetics.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO2

BSBE 0009: EVOLUTION AND ECOLOGY

OBJECTIVES: Evolution & Ecology course helps students to understand the concept of evolution of life of Earth from simple P.K. to complex E.K. Cells, direct and indirect evidences of evolution. It would provide an insight into the different forms of ecological interactions, concept of pollution ecology and comprehend the catastrophic effect of human activities which could destroy ecological harmony.

Credits: 04 **Semester V** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Origin of life-Theory of chemical evolution, Oparin's hypothesis, Miller Experiment, Protenoid microsphere, RNA first model, Origin of RNA, DNA • Theory of organic evolution-Lamarkism, Neo-Lamarkism, Darwinism, Neo-Darwinism, Germ plasm theory, Mutation theory • Direct evidences of evolution: Palaentological evidences, Fossils • Indirect evidences of evolution: taxonomy, Comarative anatomy, Connecting links, Homology, Analogy, Vestigial Organs etc. • Molecular Phylogeny: Gene and Species tree; Paralogous and homologous genes, Cladogaram and Dendrogram. Ecology: Definition, Branches of ecology, Relationship of ecology with other desciplines, Ecological tools and techniques, Significance of ecology for man • Population: Definition, Population characterstics, Population growth and forms	18
II	• Biotic Community: Definition, Organization, Interaction in biotic community: Predation, Parasitism, Amensalism, Commensalism, Protocooperation, Mutualism, Competition • Ecological Succession: Definition, Types of Succession: Lithosere, Hydrosere • Sustainable development, Energy need of population, Non renewable (Coal; Oil; Natural Gas); Renewable energy (Wind; Water, Solar, Biomass) resources and Indian Energy Policy, laws and initiatives. Use of modern Biotech approach in energy management. • Understanding nature characteristics and types of disasters, causes and effects, Geographical (Earthquake; Volcanic; Landslide), Wind and Water related disasters (Droughts, Cyclones, Tsumani), Manmade disaster (Nuclear, biological and Chemical disasters). Bioweapons. Disaster mitigation: Strategy and prevention.	24

Text book:

- Cell Biology, Genetics, Mol.Biology Evolution and Ecology — P.S. Verma

Reference books:

- Fundamental of ecology — M C Dash
- Elementary Biology — Bhatia & Tyagi

Focus: This course focuses on employability aligned with All COs

Course outcomes: The main outcomes of this course are:

CO1- It will boost student interest in the field of molecular phylogeny and opens new doors in careers related to phylogenetic analysis.

CO2- An understanding of different ecological interactions and pollution ecology will lead to an enhanced knowledge in the field of environment management and sustainable development opening new carrier avenue. (Std. placed in Nat. Res. Lab's; Birbal Sahni Inst. of Paleontology; TERI; IARI, etc.)

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO2
CO2	PO2, PO4, PO5, PO6, PO8/PSO1, PSO2

BSBC 0811: PLANT BIOTECHNOLOGY LAB

OBJECTIVES: To well verse the students with practical knowledge of plant biotechnology that they have taught in the theory and provide hands on training on practical techniques of plant tissue culture and food microbiology , food biochemistry and food biotechnology related practricle.

Credits: 02 **Semester V** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Introduction to plant tissue culture laboratory and overview of Plant Tissue culture techniques. • Prepration of explants by aseptic technique. • Prepration of Murashige-Skoog (MS) and other media for plant tissue culture. • Inoculation of explants on MS media for callus formation. • Anther culture for production of Haploid embryo. • Shoot tip culture for production of virus free plants. • Development of plantlet by embryo culture. • Extraction of genomic DNA from leaf.	30

Focus: This course focuses on employability, skill development aligned with CO1 & CO2

Course outcomes: After completion of this course, students will able to

CO1- Culture plant tissue, plant extraction and essential oil extraction

CO2- Carry out qualitative testing of food product biochemically and microbiologically.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO2

BSBC 0812 : RECOMBINAT DNA TECHNOLOGY LAB

OBJECTIVES: To make the students well verse with practical knowledge of molecular biology on the basis of the tools and techniques of recombinant DNA technology and its application on the basis of subject taught in theory.

Credits: 02 **Semester V** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Plasmid isolation • Genomic DNA isolation • Competent Cell preparation • Transformation • Gene Expression using IPTG+X-Gal system • Polymerase Chain Reaction	30

Focus: This course focuses on employability, skill development aligned with CO1

Course outcomes: After completion of this course, students will able to

CO1- Plan and perform simple experiments on DNA isolation, PCR based amplification which could lay foundations in choosing careers towards forensic sciences, criminal investigations.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO3

BSBE 0804: CHEMISTRY- III LAB

OBJECTIVES: Predict products of chemical reactions. Explain patterns of chemical reactions. Demonstrate common chemical laboratory techniques, chemical instrumentation and other appropriate technology. Demonstrate ability to work in a cooperative environment, understanding of safe laboratory practice.

Credits: 02 **Semester V** **L–T–P : 0–0–3**

Module No.	Content	Lab Hours
I	**Physical:** (1) Heat of neutralization of a strong acid and a strong base. (2) Partition coefficient determination. **Inorganic:-** (1) Preparation of the following inorganic compounds : (i) Prussian blue from iron fillings. (ii) Chrome alum. (iii) Cuprannonium Sulphate (iv) Cuprous Chloride. (v) Potassium trioxalatochromate (2) Preparation and Crystallisation: (i) Acetylation (ii) Nitration. (iii) AZO – dye formation.	30

Focus: This course focuses on skill development aligned with All COs.

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

CO1- Understand chemical reactions in terms of structure and analytical knowledge

CO2- Master in basic research skills

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO3
CO2	PO2, PO3, PO4, PO5, PO6, PO8/PSO2

BSBE 0805: GENETICS LAB

OBJECTIVES: The course helps to learn students the practical aspects of genetics

Credits: 02 **Semester V** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Observation of Drosophila- wild type and mutant type • Simple genetic problems (Problems and Interaction of genes) • Student's 't' test and Chi square test • Determination of blood group • Pedigree analysis:Symbols used in autosomal recessive disorder autosomal dominant disorder, Sex chromosomal (X & Y linked). • Blood Cells (RBC & WBC) counting using Haemocytometer	30

Focus: This course focuses on skill development aligned with CO1

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

CO1- Resolve genetical problems.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO3

BSBE 0806: PLANT SCIENCE-II LAB

OBJECTIVES: The main objective of this course is to well verse the students with practical knowledge of plant science that they have taught in the theory and provide hands on training.

Credits: 02 **Semester V** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Demonstration of reproductive parts of flowering plants • Study of structures in T.S of microsporangium (anther) • Study of structures of megasporophyll • Study of structures in T.S of megasporangium(ovule) • Collection and preservation of diseased plants • Identification of plant diseases based on symptoms • Preparation of media for isolation of different plant pathogens • Methods for isolation of different plant pathogens • Methods of staining of different plant pathogens (bacteria & fungi) • Study of characteristics of various plant pathogens through slides • Live specimens and their comparative account/study • Study of communities by quadrant method to work out frequency and density • Physico-chemical nature of soil (soil texture, pH measurement, carbonate, nitrate and base deficiency) • Determination of soil moisture percentage	30

Focus: This course focuses on skill development aligned with All COs

Course outcomes: After completion of this course, course, students will able to:

CO1- Culture, isolate and purify epiphytic and endophytic microbes form infected plant parts
CO2- They can observe the morphology by using different staining techniques.
CO3- Students can perform various experiments regarding to detection of Physico-chemical nature of soil.

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

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO6, PO7, PO8/PSO1, PSO3
CO2	PO1, PO3, PO4, PO7, PO8/PSO2, PSO3
CO3	PO1, PO4, PO5, PO6, PO7, PO8/PSO1

BSBE 0807: FOOD AND INDUSTRIAL BIOTECHNOLOGY LAB

OBJECTIVES: Students learn the practical applications of food science. It explores Food science application in food products development. Main aim of these experiments to make safe, high quality food products that is profitable to all segments of agriculture.

Credits: 02 **Semester V** **L–T–P: 0–0–3**

S.No.	Name of Experiments
1.	Demonstrates the principles of butter making.
2.	Precipitation of Casein and making of casein glue.
3.	Demonstrates the importance of salt in meat processing.
4.	Demonstrates how appearance influences our perception of how foods taste.
5.	Demonstrates the chemistry of candy making
6.	Microbial testing of Milk and milk products.
7.	Isolation Gluten from different flour and its use in Bread making.
8.	Different food sample analysis for quality.
9.	Isolation of amylase from different flours.
10.	Culturing of different microbes used in fermented food products..
11	Determination of moisture, fat, ash and fiber content of food.

Focus: This course focuses on employability, skill development aligned with All COs

Course outcomes: After completion of this course, student will able to

CO1-Understand laboratory experiments which demonstrate some simple scientific principles that apply to food and explain why and how it is possible to make certain food products
CO2- Learn microbial testing of milk and milk products.

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

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO6, PO7, PO8/PSO1, PSO3

BSBE 0808: ENZYMOLOGY LAB

OBJECTIVES: The objectives of this paper are to make students well verse with the fundamentals of enzymology

Credits: 02 **Semester V** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• To estimate standard curve of pNP so as to measure the activity of enzyme acid phosphatase • To find out the activity or amount of enzyme acid phosphatase in unit per gram of potato tissue • To determine the specific activity of enzyme acid phosphatase in Unit/mg of poatao tissue • To study the effect of substrate con. on the activity of enzyme acid phosphatase • To determine value of Km and Vmax of enzyme acid phosphatase by using following graph (i) Michaelis- Menton graph (ii) Lineweaver Burk plot (iii) Hofstee's plot • To study the effect of temperature over the activity of enzyme acid phosphatase and to determine its optimum temperatue • To study the effect of pH over the activity of enzyme acid phosphatase and to determine its pH	30

Focus: This course focuses on employability, skill development aligned with All COs

Course outcome: After completion of this course, students will be able to

CO1-Understand enzyme assay system, which will help them to cope up with research and industry related to enzymology

CO2- Understand practical aspects of enzyme kinetics

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

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO7, PO8/PSO1, PSO3

BSBE 0809: EVOLUTIONAND ECOLOGYLAB

OBJECTIVES: The main objective of this course is to well verse the students with practical knowledge of plant science that they have taught in the theory and provide hands on training.

Credits: 02 **Semester V** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Determination of the presence of carbonates and nitrates in different soil sample • Determination of physico-chemical properties of given soil samples • Determination of water holding capacity of given soil samples • Determination of presence of inorganic salts in the given soil samples • Determination of presence of phosphorous in the soil • Determination of presence of nitrates in the soil • Determination of presence of potassium in the soil • Determination of physico-chemical properties of water samples • Determination of dissolved oxygen of the given water samples • Determination of physico-chemical properties of plant	30

Focus: This course focuses on skill development aligned with All COs

Course outcomes: After completing the practical course, student will able:

CO1- To culture, isolate and purify epiphytic and endophytic microbes form infected plant parts and can observe the morphology by using different staining techniques.
CO2- To perform various experiments regarding to detection of Physico-chemical nature of soil.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO7, PO8/PSO1, PSO3
CO2	PO1, PO2, PO3, PO5, PO7, PO8/PSO2, PSO3

BSBC 0016: ANIMAL BIOTECHNOLOGY

OBJECTIVES: To understand the principles of animal cell culture and its application, *in-vitro* reproductive techniques for ovum and embryo manipulation and the concept of gene cloning and expression.

Credits: 04 **Semester VI** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Scope of animal tissue culture • Natural media and artificially defined media • Primary cell culture: Disaggregation of tissues, enzymatic disaggregation & mechanical disaggregation • Cell lines : Sub culture and maintenance of cell lines • Cryopreservation of cell lines • Large scale culture of animal cell	18
II	• Growth factors promoting proliferation of animal cells: EGF, FGF, PDGF, IL-1. IL-2, NGF and Erythropoietin • Production and application of monoclonal antibodies • Transfection of animal cell lines Expression of cloned proteins in *E.coli, S. cerviseae*, insect cells, animal cells and animals • Over production and down stream processing of the expressed proteins • Transgenic animals: Technique and application, Knock out animal production	24

Text book:

- Animal Tissue Culture by A. Wilson Aruni & P. Ramadass

Reference books:

- Biotechnology-expanding horizons — B.D. Singh
- Animal Biotechnology — M.M.Ranga
- Culture of animal cells — R.Ian Freshney
- Animal cell culture — John R.W. Masters

Focus: This course focuses on employability aligned with All COs

Course outcomes: After completing this course, student will able to

CO1-Understand the concept of monoclonal antibody technology and its application in different fields.

CO2- Understand *in-vitro* reproductive techniques for ovum and embryo manipulation. He can well explain the general principles of generating transgenic microbes and animals.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO5, PO7, PO8/PSO2, PSO3
CO2	PO1, PO3, PO5, PO7, PO8/PSO1, PSO3

BSBC 0017 : GENOMICS AND PROTEOMICS

OBJECTIVES: To expose students with resents advances in the field of Genomics & Proteomics and their implication in life sciences research.

Credits: 04 **Semester VI** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Genomics** Genome sequencing: Shot Gun, Clone Contig, Contig assembly by chromosomal walking, sequence tagged site; Genetic and Physical Mapping, Importance of map in sequence assembly Genome Annotation: identifying genes in a genome sequence, determining the function of an unknown gene	14
II	**Proteomics** Chemical classification of amino acids, Principles of protein structure (Primary, Secondary, Tertiary and Quaternary), dihedral angles (ψ and φ), Ramachandran Plot Studying the Proteome: separation of proteins using 2D Gel, identification of individual protein using MALDI-TOF, ADME-Tox properties of drug candidates. **Applications of Proteomics & Genomics** Drug Discovery and Development, Microarray Technology, Pharmacogenomics, Metagenomics, epigenomics, Chromatin immuneprecipitation sequencing (ChIP), Protein-protein interaction, Yeast-Two- Hybrid system for protein-protein interaction	14

Text book:

- Biotechnology by Dubey, R.C

Reference books:

- Introduction to Genomics. Arthur Lesk. Oxford University Press
- Brown TA, Genomes by Garland Science.
- Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and
- Bioinformatics by Benjamin Cummings.

- Primrose S & Twyman R, Principles of Gene Manipulation and Genomics by Blackwell.
- Glick BR & Pasternak JJ, Molecular Biotechnology by ASM Press.

Focus: This course focuses on employability aligned with CO2

Course outcomes: After completing this course, student will able to

CO1-Acquaint fundamental system-level understanding of cellular processes

CO2-Learn how to exploit genomics and proteomics technologies in biotechnology/microbiology related activities.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO7, PO8/PSO1, PSO3
CO2	PO1, PO3, PO5, PO7, PO8/PSO1, PSO3

BSBE 0010: FERMENTATION TECHNOLOGY

OBJECTIVES: Fermentation technology course helps students to apply the concepts learned in the area of microbiology, biochemistry for obtaining commercially important byproducts. Students are introduced to the concept of fermentation technology, scaling up techniques, wet & dry milling and the concepts, components of a bioreactor enabling students to learn the concept of aerobic, anaerobic and alcoholic fermentation leading to the production of cheese, butter, yoghurt, etc.

Credits: 04 **Semester VI** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	History and development of fermentation industry: Types of fermentations processes. Design of typical batch fermentor, Agitation, Aeration, pH, Temperature and dissolved oxygen. Factors affecting fermentor design. Types of fermenters, Computational control of fermenters Primary and secondary metabolite materials. Primary and secondary screening, Strain development strategies. Sterilization of fermentor, media and air. Raw material availability, quality, processes and pretreatment of raw Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crab tree effect, feedback inhibition and feedback repression.	18
II	Creation/procedures for developing mutants of the desired microbes with the stable capacity of producing desired metabolites. Isolation and preservation of different types of mutants induction resistant, feedback inhibition resistant. Concept for overproduction of metabolites. Fermentations of recombinant microbial cells for large-scale production of genetically. Downstream processing.	24

Text book:

- Principle of Fermentation Technology by Stanbury, O.F

Reference books:

- Murray Moo -Young, Comprehensive Biotechnology, Vol. 1 & III.
- Microbes & Fermentation, A. Lel and Kotlers Richard J. Mickey, Oriffin Publication
- Industrial Fermentations- Leland, N. Y. Chemical Publishers.
- Prescott and Dunn's- Industrial Microbiology.

- Biotechnology Series, Rehm, Reed & Weinheim, Verlag-Chemie.
- Biochemical Engg., Aiba, Humphrey & Miller, Academic Press.
- Fermentations & Enzyme technology,Wang & Humphrey, Wiley & Inter Science

Focus: This course focuses on employability, skill development aligned with All COs

Course outcomes: After completing this course, student will able to

CO1- Develop an understanding about the concept of fermentation technology, enabling them to develop innovative bioreactor systems according to the type of microbe being cultured
CO2- Use these bioreactors for the mass production of economically important food products such as cheese, butter, yoghurt, etc. (Std. placed in Nat. Res. Lab's; Yakult Int. Ltd; AMUL, etc.)

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

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO7, PO8/PSO2
CO2	PO1, PO2, PO3, PO4, PO7, PO8/PSO1, PSO3

BSBE 0011: ROLES OF BIOTECHNOLOGY IN FORENSIC SCIENCE

OBJECTIVES: Forensic technology implies the concepts of molecular biology, biochemistry and immunology to critically investigate crime scene. The course helps students to explore the techniques of molecular biology such as DNA fingerprinting; RFLP; RAPD; AFLP; PCR & STR analysis. Course also introduces the concept of forensic entomology, and the use of 12S rRNA for identification of tissue based samples and their practical applications.

Credits: 04 **Semester VI** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Introduction to forensic Sciences; • Genomic sequences present within the DNA & their types (Unique/ Moderate & highly repetitive DNA sequences); Minisatellites & Microsatellites. • Identification of animal species for processed meat products. • Biotechnology Techniques utilized in DNA profiling (DNA fingerprinting);	18
II	• Restriction fragment length polymorphism (RFLP); Random amplified polymorphic DNA (RAPD); Amplified fragment length polymorphism (AFLP); Microstallites; PCR amplifications; STR analysis. • Application of DNA profiling in crime investigation and detection. • Paternity detection.Identification of animal species using collagen fingure printing from bone marrow. • Identification of contaminated meet/ tissue based identification of the corpse of different animals using molecular approach (12S rRNA mitochondrial based).	24

Text book:

- Forensics for Dummies, M.K.Sateesh, DP Lyle, John Wiley & Sons (23 April 2004).

Reference book:

- Molecular forensics, R. Rapley, D. Whitehouse, Wiley Sciences 2007.

Focus: This course focuses on employability, skill development aligned with CO1& CO2

Course outcomes: After completing this course, student will able to

CO1- Enhance practical applications of students to uptake challenging problems associated with criminal investigations,

CO2-Understand tissues based identification of corpse, forensic entomology, paternity detection so as to enable them to choose forensic investigations as a career avenue. (Std. placed in forensic Lab's; DRDO-CEPTEM; etc.)

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7, PO8/PSO2

BSBE 0012: DEVELOPMENTAL BIOLOGY

OBJECTIVES: The course in Developmental Biology provides an insight into the genetic and physiological control of animal development especially in humans. Course aims to enhance student horizon by recollecting the concepts of Biochemistry and Cell biology to begin with the study of multicellular level of biological organization.

Credits: 04 **Semester VI** **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours
I	Heterogamy in mammals. Parthenogenesis. Testis structure, Sertoli cell, Leydig cell. Epididdymis organization and function Spermatogenesis and its hormonal regulation. Structure of sperm and function. Semen composition and formation, Biochemistry of semen. Male accessory sex glands and its function. and function. Mammalian ovary morphology, Oogenesis and Vitellogenesis, Ovulation and ovule transport, Menstrual cycle, Follicular development. Male and Female sex hormones biosynthesis,chemical nature and function. Fertilization: Prefertilization and post fertilization stage of gametes, hormonal control of fertilization. Embryonic development: Cleavage & its molecular mechanism, laws of cleavage, Blastulaion, gastrulation,neurulation, development upto three germ layers, fate of three germinal layer.	18
II	Molecular basis of cellulation and differentiation in D. melanogaster, C. elegans. Intra uterine development of mammalian foetus, foetal membranes, Amniotic fluid composition and function. Placenta structure, types and function. Pregnancy testing, Sonication. Biology of Implantation cellular and molecular aspects, markers of developing embryo. Multiple ovulation and embryo transfer technology (MOETT), Embryonic stem cell and its application. Cryopreservation of sperm, ovum & embryo along with its industrial application, *invitro* oocyte maturation and fertilization (IVF), concept of surrogacy and its regulation. Assisted reproduction technologies, Embryo sexing (Aminocentesis) and cloning, screening of genetic disorders, ICSI, GIFT etc. Cloning of animals by nuclear transfer, Teratological effects of xenobiotics, Immuno contraception: gamete specific antigens, surgical methods, hormonal methods, IUCD.	24

Text book:

- Human Embryology by Rani Kumar

Reference books:

- Animal Physiology by Kunt Schmidt, Neilson, Cambridge University Press Cambridge.
- Physiology of Mammals & other vertebrates by Marshall & Hughes. Cambridge Univrsity Press Cambridge.
- Animal Physiology by Roger Eckert & David Randall, CBS Publishers & Distributors, Delhi.
- Text of Anbimal Physiology by Hurt & Mathur, S.Chand & Co. New Delhi.
- Text of Animal Physiology by N agbushanam, Kodarkar & Sarojini, Oxford & IBI Pub. New Delhi.
- Comparative Animal Physiology (Environment & Metabolic Animal Physiology,) by CLadd Prosser, Wiley-Liss, Publication, New York
- Comparative Animal Physiology (Neural & Integrative Animal Physiology) by C. Ladd Prosser, Wiley-Liss, Publication New York.
- Human Physiology, Vol.I & II by Dr.C.C.Chatterjee, Medical applied,Agency, Calcutta

Focus: This course focuses on employability aligned with CO1 and CO2

Course outcomes: After completing this course, student will able to

CO1- Understand the concept of Pregnancy testing kits, Artificial reproductive technology and their application laying down the foundation towards a professional carrier in the budding field of ART.

CO2- Students can be placed in Cryobank; Lifecell; CIRG; TT Baby Centers, etc)

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7, PO8/PSO2, PSO1
CO2	PO1, PO2, PO3, PO4, PO5, PO7, PO8/PSO2, PSO3

BSBE 0013: HUMAN PHYSIOLOGY

OBJECTIVES:

- Demonstrate knowledge of the anatomy and physiology of human organs and organ systems
- Demonstrate a basic knowledge of molecular / biochemical processes
- Demonstrate an understanding of the impact of evolutionary forces on the human organism
- Demonstrate an understanding of the ecological context of humans

Credits: 04 **Semester VI** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Digestive system:** Organization of Gastro Intestinal Tract (Overview of Buccal cavity, Oesophaus, Stomach, Small intestine,Large intestine,Liver and Pancrease). Digestive Enzymes, Secretion of saliva, Gastric juice,Intestinal juice,Bile. Digestion and absorption of Carbohydrate, Lipid and Protein. **Circulatory system:** Structure of Heart,Arterial system,Venous system,Poratl system,Conducting sysem of heart, Heart beat, Arterial Blood Pressure, ECG, Artificial pace maker, Blood coagulation, Disorders of Circulatory System (Hyper tension, Atherosclerosis, Myocardial infraction, Rheumatic heart disease).	18
II	**Endocrinology:** Properties of Hormones, Function and Disease associated with Hypo and Hyper secretion of Hormones secreted by Pituitary gland, Pineal gland, Hypothalamus, Thyroid gland, Parathyroid gland, Thymus gland, Adrenal gland, Pancrease,Gonads, Kidney and Placenta. Pheromones, Mechanism of hormone action. Nerve Impulse Transmission, Neurotransmitter **Respiration:** Hemoglobin and myoglobin,Transport of Oxygen and Carbon dioxide in Blood, Oxygen dissociation curve, Bohr's effect and Haldane's effect, Common respiratory disorders (Hiccup,Hypoxia,Bronchitis, Asthama, Pneumonia,Diptheria). **Excretion:** Excretory system :Kidney,Ureter and Urinary bladder, Urea formation, Urine formation, Composition of urine, Acid base balance, Haemodialysis , Renal stone.	24

Text book:

- Element of Human Anatomy, Physio and Health by Goyal, Ramesh K

Reference books:

- Animal Physiology by Kunt Schmidt, Neilson, Cambridge University Press Cambridge.
- Physiology of Mammals & other vertebrates by Marshall & Hughes. Cambridge Univrsity Press Cambridge.
- Animal Physiology by Roger Eckert & David Randall, CBS Publishers & Distributors, Delhi.
- Text of Anbimal Physiology by Hurt & Mathur, S.Chand & Co. New Delhi.
- Text of Animal Physiology by N agbushanam, Kodarkar & Sarojini, Oxford & IBI Pub. New Delhi.
- Comparative Animal Physiology (Environment & Metabolic Animal Physiology,) by CLadd Prosser, Wiley-Liss, Publication, New York
- Comparative Animal Physiology (Neural & Integrative Animal Physiology) C. Ladd Prosser, Wiley-Liss, Publication New York.
- Human Physiology, Vol.I & II by Dr.C.C.Chatterjee, Medical applied,Agency, Calcutta.

Focus: This course focuses on employability aligned with CO2

Course outcome: After completing this course, students will able to

CO1- Students aware, understand the work in a diverse world of human physiology

CO2- Get suitable position in various medical transcript companies like IDS-infotech & Innodata Pvt Ltd.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO5, PO7, PO8/PSO2, PSO3

BSBE 0014: ENVIRONMENTAL BIOTECHNOLOGY

OBJECTIVES: Main OBJECTIVES of environmental biotechnology are the conservation of resources via the recycling of waste materials.The recoveries of more valuable products such as metals, oils, and vitamins are important aspects of this technology.Use of microorganisms in recovery of minerals of commercial interest is also an interesting area.Reclaiming organically polluted water, application of microbes to degrade compounds, use of animal waste as fertilizer.

Credits: 04 **Semester VI** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• **Introduction, Importance and Scope of Environment Biotechnology.** • **Renewable and Non-Renewable Resources of Energy.** • **Conventional fuels and their impact on Environment –** Firewood, Animal wastes, Coal, Petroleum and Animal oils. • **Modern fuels and their impact on environment –** Methanogenic Bacteria, Biogas Production, Microbial Hydrogen Production, Conversion of Sugar to Alcohol, Gasohol. • **Effect of Green Revolution and Industrial Revolution on Environment.** • Degradation of Pesticides and Other Toxic Chemicals by Microorganism like *B. thuringenesis.* • Degradation of Aromatic, Hydrocarbons and Petroleum Products. •	18
II	• **Ttreatment of Domestic and Industrial Wastes**- Primary, Secondary and Tertiary Treatments . • **Waste Water Pollution (Sewage) Treatment Process** - Septic tank, Mechanical and Biological Treatment, Trickling Filters, Activated Sludge Process, Oxidation Ponds, Anaerobic Sludge Digestion. • **Solid Waste Disposal-** Sanitary Landfills, Composting, Vermicompost**.Biofertilizers-** Defination, Distinguished Features of Biofertilizers and Organic Manures. • Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil, Algal and fungal biofertilixers (VAM) • **Bioleaching-** Ore Leaching and Role of Microbes in Mines (copper, and Uranium) • Environmental significance of Genetically modified microbes, plants and animals . • Bio-assessment of environmental quality.	24

Text book:

- Fundamental of Environmental Studies by Bharrgava, D.S

Reference books:

- John E Smith – Biotechnology, Cambridge University Press
- Presscott & Dunn - Industrial Mcrobiology, AVI publishing Co. USA
- Mukerji, Singh & Garg - Frontiers in applied Microbiology, Prink House India, Lucknow
- Peppler & Perlman – Microbial Technology, Academic Presss, New York
- Nicholas C Price – Fundamentals of Enzymology
- Chaplin & Bueke – Enzyme technology
- Moses and Capes – Biotechnology- the Science and Busines

Focus: This course focuses on employability, skill development aligned with All COs

Course outcomes: After completing this course, student will able to

CO1-Understand the importance of microbial diversity in environmental systems, processes and biotechnology.
CO2-Understand existing and emerging technologies that are important in the area of environmental biotechnology.
CO3-Understand biotechnological solutions to address environmental issues including pollution, mineral resource, renewable energy and water recycling.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO5, PO7, PO8/PSO2, PSO3
CO2	PO1, PO3, PO6, PO7, PO8/PSO2
CO3	PO1, PO3, PO5, PO6, PO7, PO8/PSO1, PSO3

BSBE 0015: CLINICAL BIOCHEMISTRY

OBJECTIVES: The objective of this course is to develop an understanding of specialized technologist biochemistry of clinical laboratories in hospitals.

Credits: 04 **Semester-VI** **L:T:P- 4:0:0**

Module No.	Content	Teaching Hours
I	**Basic concepts of Clinical Biochemistry** A brief review of Units and abbreviations used in expressing concentrations and standard solutions. specimen collection and processing (Blood, urine, faeces). Anti-coagulant preservatives for blood and urine. Transport of specimens. **Disorders of mineral metabolism** Hypo-Hypercalcemia, Hypo- Hyperphosphatemia, Disorders of amino acids, steroids and vitamins, Disorders of erythrocyte metabolism: hemoglobinopathy, thalassemia & anemia. Biochemical Hazards of dangerous environment pollutants. **Inborn errors of metabolism** Introduction, clinical importance, phenyl ketonuria, cystinuria, alkaptonuria, Fanconi's syndrome, galactosemia, albinism, tyrosinemia, and hamophilia.	18
II	**Clinical drugs** Fluid & electrolyte balance and imbalance in various diseases. Function tests of pancreas, gastric, Thyroid, Kidney and liver. Direct, indirect wander wall's test & their clinical significance. **Clinical drugs** Mechanism of drug action- Penicillin, Tetracycline,Streptomycin, Chloramphenicol & Sulphonamides. Apoptosis: Carcinogens, Cancerous growth & Chemotherapy, radioactivity: radioisotopes in medicine **Clinical enzymology** Enzyme patterns in acute pancreatitis, liver damage, bone disorder, myocardial infarction and muscle wasting. Cerebrospinal fluid (CSF) chemistry and clinical significance. Biochemistry of detoxification, Xenobiotic metabolism. Metal ion toxicity, chelation therapy, antioxidant therapy. Biochemistry of Ageing, Cancer, AIDS. Functional and non-Functional plasma enzymes. Isoenzymes with examples.	24

Text book:

- Text book of Clinical Biochemistry - Carl A. Burdis and Edward R Ashwood
- Clinical chemistry in diagnosis and treatment- Philip D. Mayne
- Clinical chemistry- William Hoffman

Reference books:

Text book of Medical Biochemistry- Dr. M.N. Chatterjee and Rane Shinde

Focus: This course focuses on entrepreneurship, skill development aligned with All COs

Course outcomes: After completing this course, student will able to

CO1- Demonstrate the ability to plan an effect the change in laboratory practice and health care delivery system

CO2-Demonstrate interest in continued learning and research for personal and professional advancement

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO5, PO7, PO8/PSO2, PSO3
CO2	PO1, PO3, PO6, PO7, PO8/PSO1

BSBC 0813: ANIMAL BIOTECHNOLOGY LAB

OBJECTIVES: To develop skills of the students in the area of animal biotechnology and to learn about cell culture techniques.

Credits: 02 **Semester VI** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Demonstration and working of laminar air flow, autoclave, hot air oven, BOD incubator, CO2 incubatorwater bath, Centrifuges and microscopes. • Washing and sterilization of glasswares for *in vitro* culture • Washing and sterilization of filter assemblies • Prepration and sterilization of culture media and reagents. • Isolation of lymphocytes from blood. • Counting of viable cells by trypan blue dye with the help of haemocytometer. • Prepration of primary culture from spleen. • Feeding of cells growing in monolayer. • Subculture of monolayer/ suspension cultures • Splenocyte proliferation assay by MTT dye method • To evaluate the effect of drugs on cell proliferation. • Coning of monolayer cells. • Cryopreservation of cultured cells.	30

Focus: This course focuses on employability, skill development aligned with All COs

Course outcomes: After completing this course, student will able to

CO1- Understand aseptic handling of tissues as well as various animal tissue culture methods.
CO2- Have better understanding of Cryopreservation of cultured cells so as to become employable in various companies line Life cell international etc.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO7, PO8/PSO2, PSO3

BSBC 0814: GENOMICS AND PROTEOMICS LAB

OBJECTIVES: To inculcate in students, adequate bioinformatics skills so as to identify computational possibilities in life-science research

Credits: 02 **Semester VI** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Phylogenetic Analysis using Phylip: Botstraping, distance based and character based methods • Molecular DOCKING using Hex/AutoDock • Introduction to PERL Programming for Bioinformatics • Elementary statistics using R	30

Focus: This course focuses on employability, skill development aligned with CO1 & CO2

Course outcomes: After completing this course, student will able to

CO1-Effectively use tools and techniques used in genomics & proteomics

CO2- Have better understanding of phylogenetic analysis and molecular docking so they become employable in genomics and proteomics based industrial organization

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO5, PO7, PO8/PSO1, PSO2

BSBE 08010: FERMENTATION TECHNOLOGY LAB

OBJECTIVES: Learn the components of fermentor designing and use of fermentation technology in development of different fermented food products and applications in food science. Main aim of these experiments to make safe, high quality fermented food and beverages products that are profitable to all segments of society..

Credits: 02 **Semester VI** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Introduction to different fermentor used in food industries by video. • Mantling and dismantling of Bioreactor for study of its components. • To study the Growth kinetics in batch fermentation process. • Isolation of Aspergilus niger fungi and its characterization. • Prepration of different media used in fermented food product. • Prepration of vinegar and wine from fruit and plant juice. • Isolation Gluten from different flour and its use in Bread making. • Prepration of filter using glass wool used in different fermentor. • Study the rheology of the different fermentation broth. • Screening of different microbes used in fermented food products.	30

Focus: This course focuses on employability, skill development aligned with CO1

Course outcomes: After completing this course, student will able to

CO1- Expertise in fermentation technology, handling of Bioreactor and production of fermented food and beverages so that students can get the job in food and beverages industries.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7/PSO1, PSO3

BSBE 0811: ROLE OF BIOTECHNOLOGY IN FORENSIC SCIENCE LAB

OBJECTIVES: Forensic technology implies the concept of molecular biology, biochemistry and immunology to critically investigate crime scene. Practical's will help students to gain an insight in the techniques used in forensic sciences such as blood group analysis, paternity detection, RFLP, RAPD and PCR analysis

Credits: 02 **Semester VI** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Inroduction to forensic Sciences laboratory, precaution during collection of samples from Crime spot. • Circumstancial Evidences (causes of death: Case studies (poisoning, choking, stabbing, suffocating, drowning etc) • Calculating the time of death (Biological versus clinical death) • Blood group testing • Paternity Analysis (Pedigree analysis) • Isolation of genomic DNA • DNA fingerprinting analysis • Use of PCR in amplification of Genomic DNA • Restriction fragment length polymorphism (RFLP)	30

Focus: This course focuses on employability, skill development aligned with CO1

Course outcomes: After completing this course, student will able to

CO1- Enhance practical applications of students to uptake challenging problems associated with criminal investigations; tissue based identification of corpse, forensic entomology, and paternity detection so as to enable them to choose forensic investigations as a career avenue. (STD. placed in forensic Lab's; DRDO-CEPTEM; etc.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO7/PSO2, PSO3

BSBE0812: DEVELOPMENTAL BIOLOGY LAB

OBJECTIVES: To provide a glimpse of scope and historical background of developmental biology to the students. To impart knowledge regarding basic concepts of differentiation and growth. It provides glimpses of scope during the development of embryo to the students.

Credits: 02 **Semester VI** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Demonstration of Binary fission in amoeba • Demonstration of budding in yeast • Study of mitosis and meiosis using available materials • Study of permanent slides showing cell division at different stages • Study the development of ovum and the maturation of graffian follicle with the help of permanent slides • Study of histology of testis using permanent slides • Study the morphology of sperm from the semen of animals • Histopathological studies of uterus with the help of slides	30

Focus: This course focuses on skill development aligned with All COs

Course outcomes: After completing this course, student will able to

CO1- Learn about modern implications of developmental biology by impartment of knowledge regarding the structure of reproductive organs, development of male and female gametes and embryogenesis.

CO2-This practical experience will help them in the development of advanced techniques like, in-vitro fertilization and stem cells therapy.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO7/PSO2, PSO3
CO2	PO1, PO2, PO4, PO5, PO8/PSO1, PSO2

BSBE0813: HUMAN PHYSIOLOGY LAB

OBJECTIVES: The purpose of this laboratory course is to give you experience with the scientific investigation of human physiological processes. You will measure the ways in which the body responds to varying stimuli and observe how those responses contribute to the maintenance of homeostasis. The labs are not only designed to support physiological concepts learned in lecture, but to demonstrate the process of scientific investigation as well. We firmly believe the journey is just as important as the destination and experimental methodology will be emphasized.

Credits: 2 **Semester VI** **L–T–P:0-0-3**

Content	Lab hrs.
• Check the presence of glucose in the given sample • Histological slides of different organ of mammals • Blood grouping testing • Check the permanent slides of meiosis and mitosis • Barr body test • Quantitative analysis of glucose and cholesterol test • Demonstrate the presence of protein in the given sample • DLC and RBC count • Demonstrate Widal test • Check hemoglobin, RBC ,WBC and platelets using hematology analyzer • To check the percentage of hemoglobin by hemoglobinometer • To check blood pressure: Systolic and Diastolic Blood Pressure	30

Focus: This course focuses on skill development aligned with All COs

Course outcomes: After completing this course, student will able:

CO1- Describe with detail the functioning of specific body systems at both the cellular level and at the system level to predict a response to changes in homeostasis.

CO2- Apply your understanding of the individual systems to interactions between multiple systems.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO8/PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PO5, PO7/PSO2, PSO3

BSBE0814: ENVIRONMENT SCIENCE LAB

OBJECTIVES: The main objective of this course is to provide the practical exposure of environmental pollutants in water, air and soil to the students. The environmental science prepares you for career success in natural resources and conservation, public health, environmental monitoring and remediation, industrial environmental management.

Credit: 2 **Semester: VI** **L:T:P -0:0:3**

Content	Lab hrs.
• Determination of moisture content of soil samples. • Collection, processing and storage of effluent samples. • Determination of chemical oxygen demand in waste water sample. • Determination of dissolved oxygen in waste water sample. • Determination of total dissolved solids in waste water sample. • Analysis of total hardness of waste water sample. • Determination of total alkalinity in waste water sample. • Determination of chlorine in waste water sample.	30

FOCUS: This course focuses on entrepreneurship, skill development aligned with All COs

COURSE OUTCOMES: After completing this course, student will able to

CO1-Handle the various pollutants present in air, water and soil and also

CO2-Develop a sense of community responsibility by becoming aware of scientific issues in the larger social context.

CO3- Have better understanding of environmental issue so they can start up program for the betterment of mankind.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO6, PO8/PSO1, PSO3
CO2	PO1, PO2, PO4, PO5, PO7/PSO2

BSBE0815: CLINICAL BIOCHEMISTRY LAB

OBJECTIVES: The objective of course is to impart knowledge about the methods of measurement and determination of glucose, cholesterol, ALT, AST, Serum creatine, Serum albumin, hormones in physiological fluids.

Credit: 2 **Semester: VI** **L:T:P-0:0:3**

Content	Lab hrs.
• Estimation of serum blood glucose • Estimation of serum cholesterol • Estimation of ALT and AST • Estimation of serum creatine and albumin • Estimation of serum T3, T4 and TSH. • Estimation of FSH and LH. • HCG based pregnancy test. • Estimation of serum electrolytes.	30

Focus: This course focuses on employability, skill development aligned with All COs

Course outcomes: After completing this course, student will able to

CO1- Understand the design, operation and performance of the approaches used to measure glucose, cholesterol, ALT, AST, serum creatine, serum albumin and hormones for job in pathological labs

CO2- Develop practical skills necessary for understanding and independent solving problems in the field of biochemistry using a standard methodology.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7, PO8/PSO1, PSO3
CO2	PO1, PO3, PO4, PO6, PO8/PSO1, PSO3

BSBC 0815: PROJECT WORK

Credits: 5 **Semester VI** **L–T–P:**

Module No.	Content	Teaching Hours
I	Project work	2 months

Focus: This course focuses on skill development aligned with CO1

Course Outcome: After completion of this course, students will able to

CO1. Learn fundamental and advanced biotechnological techniques used in different field for the production of useful product and for the betterment of society

COURSE STRUCTURE

(w.e.f. Session 2020-21)

B. TECH BIOTECH

BMAS 0130: ELEMENTARY MATHEMATICS I

Course Objectives: To make the students understand the concepts of algebra and differential calculus.

Credits: 04 **Semester I** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours (Approx.)
I	**Algebra:** Complex numbers, Solution of quadratic equations, Introduction to matrices, Types of matrices, Operations on matrices, Minors and Co-factors, Determinant, Transpose, Adjoint and Inverse of a matrix, Solution of system of linear equations by Cramer's rule, Partial fractions.	20
II	Introduction to Vector algebra, Scalar & Vector products, Collinear and Coplanar vectors. Arithmetic and geometric progression. **Differential Calculus:** Functions, Properties of standard functions (trigonometric, exponential and logarithmic) and their graphs, Concept of limit, Differentiation of algebraic, exponential, logarithmic, trigonometric, inverse trigonometric and hyperbolic functions, Product, quotient and chain rules, Maximum and minimum of a function of one variable.	20

Learning Outcomes:

After studying these topics, the student will be able to

- Determine the roots of a quadratic equation
- Find the inverse of a given matrix and solve the systems of linear equations
- Know arithmetic and geometric progressions
- Learn the concept of vectors and vector products
- Understand the differentiation of a function and its applications

Text Books:

- P. Banerjee, Introduction to Biostatistics, S. Chand & Co., Delhi, 2006.
- Mathematics books for Class XI & XII, NCERT Publications.

Reference Books:

- G. B. Thomas and R. Finney, Calculus & Analytic geometry, Addison Wesley, USA, 1995.
- P. Gupta, Comprehensive Mathematics (for Class XI & XII), Laxmi Pub. (P) Ltd. Delhi.

BBTC 0001: INTRODUCTION TO BIOLOGY

OBJECTIVES: *This is an introductory course in biology which gives detail study on natural sources of plant and animal origin. Subject deals with the plant cell, animal cell classifications plant kingdom and study of animal issues.*

Credits: 04 **Semester II** **L–T–P: 3–1–0**

Module	Contents	Hrs.
I	• Cell: Cell types, Structure and functions of Cell Wall and Plasma membrane. • Cellular Organelles: Ultra structure and function of mitochondria, golgi body, endoplasmic reticulum and ribosomes. • Nucleus: Ultra structure and function of nucleus. • Chromosomes: Structure and composition. • Cytosol: Structure and functions • Cell cycle and Cell division (meiosis and mitosis). • Morphology and anatomy of root, stem and leaves. • Plants tissues: Structure and functions.	18
II	• Transpiration: Definition and Mechanism of transpiration • Photosynthesis: Definition, Light and dark reaction, C2, C3 and C4 cycle. • Respiration in plants: Definition, Glycolysis and TCA cycle • Plant growth and developments • Structure of plant cell • Systematic and binomial system of nomenclature • Viruses: Introduction, morphology and classification	24

TEXT BOOK:

- Cell biology, S.C. Rastogi Rastogi publication

REFERENCE BOOKS:

- Biotechnical cell biology,Veer Bala Rastogi, rastogi publication
- Cell biology, Genetics, Mol. Biology, P. S. Verma & V.K. Agrawal, S. Chand publication

OUTCOME:

Student will learn details about plant and animal cells plant taxonomy classification and some aspects of physiology of animals.

BCHS 0102: ENGINEERING CHEMISTRY

Objective:

1. *This course aims to expose the students to the various methods of fabricating commercially useful polymers, Nanomaterials and other materials and lubricants used in machinery parts*
2. *The course takes the students to integrate concepts, mechanism and control of corrosion and processes of treatment of water and to provide basic knowledge of various spectroscopic techniques like IR, UV, MS, and NMR.*

Credit: 4 **Semester: I** **L-T-P: 3-1-0**

Module No.	Content	Teaching Hours
I	**Chemical Bonding:** M.O. theory and its applications in homo & hetero diatomic molecules. Hydrogen bond, metallic bond and their applications. Semi-conductors. **Stereochemistry:** Types of isomerism (optical and geometrical) chirality, elements of symmetry, diastereomers, optically active compounds, R-S configuration and E-Z geometrical isomers, conformation of ethane and *n*-butane. **Polymers:** Polymerization and its classification. Preparation, properties and uses of polymers: Thermoplastics (Polystyrene, Teflon and Nylon 66), Thermosetting polymer (Bakelite). Biodegradable polymers (PLA, poly β-hydroxy butyrate), molecular weights of polymers, natural rubber and its vulcanization, synthetic rubber (neoprene, Buna-S, Buna-N). **Fuels**: Definition and classification of fuels. Analysis of coal and determination of calorific value by bomb calorimeter. **Synthetic petrol**: Bergius and Fischer -Tropschs methods **Lubrication:** Introduction, classification, properties & uses of lubricants. **Ceramics:** Introduction, classification, scope & applications. **Glass:** Preparation, varieties & uses.	24
II	**Water Treatment:** Introduction, hardness and its units, L-S Process, calgon process, zeolite and ion-exchange processes, reverse osmosis, treatment of municipal water, impurities in water, boiler feed water, boiler troubles and remedial measures **Functional materials:** Biomaterials, smart materials (piezoelectric, pyroelectrics & ferroelectrics) and advanced materials **Corrosion**: Introduction, consequences, types, theories of corrosion, (galvanic, pitting, stress, water line, intergranular & soil corrosion) and protection of corrosion. **Spectroscopy:** Elementary ideas and simple applications of UV, visible, infrared and NMR spectral techniques **Chemical Kinetics:** Order and molecularity of reactions, zero order, first and second order reactions. Integrated rate equations. Theories of reaction rates, factors affecting rate of reaction. pH, buffer solution (Henderson-Hasselbalch equation). **Introduction to Nanoscience & Nanotechnology:** Basic concepts of nanoscience and nanotechnology, fullerenes, graphenes, carbonnanotubes, principle and uses of SEM & TEM techniques. Applications of nanomaterials.	24

Reference Books:

1. Engineering Chemistry by Jain & Jain, Dhanpat Rai Publishing,

2. Shashi Chawala, "Theory and practical of engineering chemistry", 4th edition, Dhanpat Rai & Co. pvt Ltd.
3. S.S.Dara, "Text book of engineering chemistry and pollution control", 2nd edition, S. Chand and Co.ltd.
4. Nanotechnology: Fundamentals and Applications by Manasi Karkare

BELH 0001: ENGLISH LANGUAGE SKILLS FOR COMMUNICATION-I

Objective: *The core objective of this course is to equip the students with the essential knowledge of grammar, thereby enabling them to write and speak English with considerable accuracy. It will also enhance their linguistic competence in comprehending the written and the spoken English.*

Credits: 02 **Semester: I** **L–T–P: 2–1–0**

Module No.	Contents	Teaching Hours
I	**Parts of Speech:** Noun, kinds and usage Pronoun, kinds and usage Adjectives and their degrees **Articles:** Definite and Indefinite articles **Preposition** **Paragraph Writing:** Short paragraphs on the given topics **Vocabulary**: Words Often Confused **Texts:** 'The Eyes are Not Here' by Ruskin Bond 'What We Must Learn from the West' by Narayana Murthy **Reading Comprehension** (Unseen)	**21**
II	**Verb:** Main Verbs – Transitive and intransitive verbs Forms of verbs Auxiliary Verbs and Modal Verbs Linking Verbs Question Tags **Adverb:** Usage and positioning of adverb **Tenses and Usage:** Present, Past and Future **Correction of Errors:** Error correction on the topics covered in module I & II **Reading Comprehension** (Unseen) **Writing Skill:** Describing Pictures **Text:** 'After Twenty Years' by O' Henry	**24**

Recommended Reading:
English Teacher by R.K. Narayan

References:
1. Course Handbook (Collection of Short Stories, One Act Play&Essays)
2. English Grammar & Use by Raymond Murphy, IV Edition, Cambridge University Press, UK
3. Living English Structure by W.S. Allen, Pearson India

BEEG1001: BASIC ELECTRICAL ENGINEERING

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

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", Edition 2008, Oxford University Press.
• H. Cotton, "Advanced Electrical Technology", 2nd Edition 2009, Wheeler Publishing.
• I. J. Nagarath, "Basic Electrical Engineering", 2nd 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.

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

1. *Define the basic concept of Active and Passive elements, Linear & non-linear elements, Unilateral and Bilateral Elements. Sources-Ideal & Practical voltage and current sources.*
2. *Explain the concept of KVL/KCL and can calculate the current, voltage and power by using nodal method, mesh method, Thevenin's theorem, Super position Theorem and Maximum power transfer theorem.*
3. *To evaluate the steady state behavior of single phase and three phase AC electrical circuits.*
4. *Analyze the Magnetic circuit, principle of operation and efficiency of transformer.*
5. *Analyze the components of low voltage electrical installation.*
6. *Explain the various machines like DC Machine, Induction motor and synchronous motor in terms of working principle and applications.*

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. **Functions:** Defining & Calling a function, Passing arguments to functions – Mutable & Immutable Data Types, Different types of arguments, Recursion, Scope of variables;	21
III	**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.	21

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.

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

- Understand to solve problems with smaller Lines of Code using Python as compared to other programming languages
- Use OO concepts while programming in Python
- Use in-built packages defined in Python
- Work with Python using GUI

BCHS: 0801 ENGINEERING CHEMISTRY LAB

Objective: *The subject intends to provide understanding of the fundamental concepts of Chemistry with practical exposure applicable in Engineering Sciences thereby preparing the students for a rewarding career in science and technology.*

Credits: 01 **Semester I** **L–T–P: 0–0–2**

Module No.	Content	Lab hours
I	• To prepare standard solution of sodium hydroxide N/10 by standardizing with the help of standard solution of oxalic acid. • To determine the strength of the given HCl solution using pH meter • Determination of temporary, permanent and total hardness of water sample by complexometric method using EDTA as complexing agent. • Determination of constituents and amount of alkalinity in a given water sample. • To determine the chloride ion in the given water sample by Argentometric method (Mohr's method). • Determination of Iodine value of given oil sample. • Determine of viscosity and surface tension of the given liquid. • Determination of rate constant for acid catalyzed hydrolysis of ethyl acetate through titration. • Determination of iron concentration in the sample of water by colorimetric method. The method involves the use of KCNS as color developing agent and the measurement are carried out at λ_{max} 480 nm. • To determine the ferrous ion content in the given iron ore by titrimetric analysis against standard $K_2Cr_2O_7$ solution using K_3 [Fe (CN) $_6$] as an external indicator. • To determine the percentage of available chlorine in the given water sample of Bleaching Powder by iodometric titration using starch as an internal indicator. • To determine the % of moisture in a given sample of coal by proximate analysis	24

Outcome:

- Knowledge of Chemical Sciences for better appreciation of applications in engineering sciences.
- The student's ability to perform experiments, analyze and interpret the data of experiments will be enhanced.

BELH 0801: ENGLISH LANGUAGE LAB

Objective: *This lab course focuses on giving the students an opportunity of practicing spoken English with a view to bring fluency, accuracy and correct pronunciation and intonation in their language. It will also provide them with a platform to practice language in various social and professional settings.*

Credit: 01 **Semester: I** **L–T–P: 0–0–2**

Module No.	Contents	Teaching Hours
I	**Audio Visual Material for Listening and Speaking** The Power of English: How English became a global language **(Documentary Storm)** Entry level recording by students Sounds of English (Sky Pronunciation) **(Speech craft/sound of English)** Listening Comprehension: Internet Addiction **(Comprehension practice/Technology)** Video Clips on Spoken English **(Movie speech-yard/video clips)** 'Ancient India's Engineering Skills': A documentary **(Document/Technology)** **Speaking Activities:** Introduction of the Students Practicing pronunciation (with the help of dictionary) Situational Role Plays Discussion on the issues related to listening exercises Discussion on the India's Skills	**14**
II	**Audio Visual Material for Listening and Speaking** Listening Comprehension: Indra Nooyi **(Comprehension /People/2)** Interview of Ratan Tata & Narayan Murthy **(Speech craft/Enterprising India)** Dialogues 'The thrilling potential of 6th sense technology' (TED) **(Speed craft/popular speech)** One Way Ticket to Mars Mission **(Comprehension practice/Technology)** Short Fiction: "The Necklace" **(Short fictions/Classic)** Role Play Exit level recording **Speaking Activities** Activity: Describe your role model Role Plays and Discussion on Entrepreneurship Describing process Discussion related to audio-visual activities Picture Discussion	**16**

Audio-Visual Material:

itell: Study Material of 'Orell' Digital Language Lab.

References:

1. Norman Lewis, *Word Power Made Easy*, Goyal Publications & Distributers, Delhi.
2. Mohan, Krishan & N.P. Singh, *Speaking English Effectively*, Macmillan India Ltd., New Delhi
3. *Cambridge English Pronouncing Dictionary* by Daniel Jones

Outcome: After the completion of the course students will be able to:

1. Demonstrate an understanding of Listening and understanding English correctly.
2. Acquire correct pronunciation.
3. Improve vocabulary.

Enhance speaking skills, confidence and overcome hesitation in conversing in English.

BEEG0800: ELECTRICAL ENGINEERING LAB

Objective: *To provide exposure to the students with hands on experience on basic Electrical & Electronics circuits.*

Credits: 01 **Semester: I** **L–T–P: 0–0–2**

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. To Study Various Logic Gates Such As OR, AND, NOT, NAND, NOR. 8. Study of CRO and Measurement of Voltage and Frequency Using CRO. 9. V-I Characteristics of Zener Diode. 10. Identification of Active and Passive Components. 11. V-I Characteristics of Bipolar Junction Transistor in Common Base Mode.	24

Outcomes: *At the end of the course students will be able*

1. *To construct basic circuits.*
2. *To construct circuits on a breadboard.*
3. *To measure the various electrical quantities(like voltage, current, frequency and power)*
4. *To measure resistance using DMM*
5. *To measure energy using single-phase energy meter.*
6. *To understand working of 1-phase transformer.*
7. *To write satisfactory laboratory reports.*

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 and 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 ofUser-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.

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

- solve problems with smaller Lines of Code using Python
- use OO concepts while programming in Python
- use in-built packages defined in Python
- use front-end as Python Programming to connect with any back-end

BME G0801 ENGINEERING DRAWING

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 **Semester I** **L–T–P: 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 to other plane. (1Drawing sheets) **Development of surfaces-** Development of prisms, pyramids and cylindrical & conical surfaces (1Drawing sheets) **Isometric projection -**Isometric projection and isometric views of different planes and simple solids (1Drawing sheets) **Computer aided drafting** Introduction to computer aided drafting package to make 2-D drawings.	**24**

References:

- Bhatt, N. D. and Panchal, V.M., 'Engineering Drawing', Pub- Charotar Publishing House.
- Natarajan, K. V., 'A text book of Engineering Graphics', Pub- Dhanalakshmi Publishers, Chennai.
- Venugopal, K. and Prabhu Raja, V., 'Engineering Drawing and Graphics + AutoCAD', Pub- New Age International.
- Jolhe, D. A., 'Engineering drawing', Pub- Tata McGraw Hill.
- Shah, M. B. and Rana, B. C., 'Engineering Drawing', Pub-Pearson Education.
- Trymbaka Murthy, S., 'Computer Aided Engineering Drawing', Pub- I.K. International Publishing House.
- Agrawal & Agrawal ,C., 'Engineering Drawing'Pub Tata McGraw Hill

Course Outcomes:

At the end of the course the student will be able to

- *Use common drafting tools to construct engineering drawings and apply dimensions on engineering drawings. Create, construct and Interpret views and sectional views and projections. Create isometric and oblique sketches and identify standard features*

- *Use SI units, and standards scales to produce engineering drawings.*

BMAS 0131: ELEMENTARY MATHEMATICS II

Course Objectives: *To make the students understand the advanced concepts of integration, ordinary differential equations and biostatistics.*

Credits: 04 **Semester II** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours (Approx.)
I	Integration of algebraic, exponential, logarithmic, trigonometric and hyperbolic functions, Integration by parts, substitution & partial fractions, Definite integrals and its properties. Introduction to Biostatistics, Measures of central tendency and dispersion.	20
II	Differential equation, order, degree, Solution of ODE of I order and I degree (Variable separable, homogeneous, linear and exact forms) and its applications to biological problems (population growth, radioactive decay). Correlation and Regression, Computation of moments, Skewness and Kurtosis by the method of moments.	20

Learning Outcomes:

After studying these topics, the student will be able to

- Find the integration by various methods
- Solve the ordinary differential equations of first order and first degree
- Understand the concepts of measures of central tendency
- Calculate moments, correlation and regression

Text Books:

- P. Banerjee, Introduction to Biostatistics, S. Chand & Co., Delhi, 2006.
- Mathematics books for Class XI & XII, NCERT Publications.
- B. K. Mahajan, Methods in Biostatistics, Jaypee Brothers Pub., New Delhi, 2010.

Reference Books:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.

BPHS0002: ENGINEERING PHYSICS

Objective: *This course has been designed with the special focus on the applications of Mathematics in distinct engineering branches.*

Credits: 04 **Semester II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	1. Wave Optics: .Coherent sources, Fresnel's biprism, Interference in uniform and wedge shaped thin film, Necessity of extended sources, Newton's rings and its applications. Fraunhofer diffraction due to single slit and Qualitative description of N slits diffraction (no derivation), Spectra with grating.), Concept of polarization of light, Phenomenon of double refraction, Optical activity and Specific rotation. 2. Electromagnetism: Displacement current, Continuity equation, Maxwell's equations, Propagation of E M waves in vacuum and in conducting medium, Skin depth, Poynting vector and Poynting theorem, Plane electromagnetic wave in vacuum and their transverse nature.	20
II	1.Special Theory of relativity: Inertial & non-inertial frames, Galilean Transformations, Einstein's postulates, Lorentz transformation equations; Length contraction, Time dilation, Addition of velocities, Variation of mass with velocity, Mass energy equivalence (Einstein's Mass relation).Relativistic relation between energy and momentum, Massless particles. 2.Introduction to Quantum Mechanics: Black body radiation, Stefan's Law, Wien's law, Rayleigh-Jeans law and Planck's radiation law. Wave - particle duality, de-Broglie hypothesis, wave packet, Heisenberg's uncertainty principle and its applications;(Non-existence of electrons in nucleus and Bohr's first orbit radius), Wave function and its normalization, Schrödinger's wave equation: time dependent and time independent, Particle in one dimensional , Expectation values of dynamical variables.	20

Reference Books:

1. Concept of Modern Physics - by Beiser (Tata Mc-Graw Hill)
2. Materials Science and Engineering - by V. Raghavan (Prentice- Hall India)
3. Quantum Mechanics by Satya Prakach.

BTBC 0002: ANIMAL AND PLANT PHYSIOLOGY

Objective: *This course has been designed to well-versed the students with basic concepts of animal and plant physiology, which will be further used various advancement going in the field of biotechnology.*

Credits: 04 **Semester II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	Digestive system: Organization of Gastro Intestinal Tract (Overview of Buccal cavity, Oesophaus, Stomach, Small intestine, Large intestine, Liver and Pancreas). Digestive Enzymes, Secretion of saliva, Gastric juice, Intestinal juice, Bile. Digestion and absorption of Carbohydrate, Lipid and Protein. Circulatory system: Structure of Heart, Arterial system, Venous system, Poratl system, Conducting sysem of heart, Heart beat, Arterial Blood Pressure, ECG, Artificial pace maker, Blood coagulation, Disorders of Circulatory System (Hyper tension, Atherosclerosis, Myocardial infraction, Rheumatic heart disease). Endocrinology: Properties of Hormones, Function and Disease associated with Hypo and Hyper secretion of Hormones secreted by Pituitary gland, Pineal gland, Hypothalamus, Thyroid gland, Parathyroid gland, Thymus gland, Adrenal gland, Pancreas, Gonads, Kidney and Placenta. Reproductive hormones, Pheromones, Mechanism of hormone action. Nerve Impulse Transmission, Neurotransmitter	21
II	Plant Water Relations: Diffusion, Osmosis, Permeability, Imbibition, Plasmolysis, Osmotic potential, Water potential, DPD, Types of soil water, Mechanism of active and passive water absorption Ascent of sap: Definition, Theories of ascent of sap Transpiration: Definition, Types, Stomatal apparatus, Stomatal periodicity, Mechanism of stomatal movements, Factors affecting stomatal movements, Factors affecting transpiration, Significance of transpiration, Wilting, Antitranspirants, Guttation Photosynthesis: Introduction, Significance, Historical aspects, Photosynthetic pigments, Concept of two photosystems, Light phase: Cyclic and Non cyclic photophosphorylation (z scheme), Dark phase: Calvin cycle (C3), Hatch and Slak cycle (C4) and CAM pathway, Photorespiration (C2 cycle), significance of Photosynthesis Respiration: Introduction, Types, RQ, Glycolysis, Kreb's cycle, Factors affecting respiration, Fermentation	21

Text Book:

- Element of Human Anatomy, Physio and Health by Goyal, Ramesh K
- Unified Botany 3rd Year by Agrawal, S.B

Reference Books:

- Animal Physiology, 1990 4th edn. Kunt Schmidt, Neilson, Cambridge University Press Cambridge.

- Physiology of Mammals & other vertebrates, 1980, 2nd edn. Marshall & Hughes. Cambridge Univrsity Press Cambridge.
- Animal Physiology, 1987, Roger Eckert & David Randall, CBS Publishers & Distributors, Delhi.
- Text of Anbimal Physiology, 1976, Hurt & Mathur, S.Chand & Co. New Delhi.
- Text of Animal Physiology, 1991, 2nd edn,N agbushanam, Kodarkar & Sarojini, Oxford & IBI Pub. New Delhi.
- Comparative Animal Physiology (Environment & Metabolic Animal Physiology,) 4th edn. 1991, CLadd Prosser, Wiley-Liss, Publication, New York
- Comparative Animal Physiology (Neural & Integrative Animal Physiology), 1991, 4th edn. C. Ladd Prosser, Wiley-Liss, Publication New York.
- Human Physiology, Vol.I & II 1980.12th edn.Dr.C.C.Chatterjee, Medical applied,Agency, Calcutta.
- Botany, Author: A.C.Dutta, Pub: oxford university press
- Elementary Biology, Author: Bhatia & Tyagi, Pub: trueman book company
- A Test Book of Plant Physiology, Biochemistry & Biotechnology, Author: Verma & Verma, Pub: S.chand
- Plant Physiology, Author: Salisbury & Ross, Pub: WADSWORTH Cengage learning
- Unified Botany, Author: Agrawal S.B, Pub: Shivlal Agrawal

BELH 0002: ENGLISH LANGUAGE SKILLS FOR COMMUNICATION-II

Objective: *The objective of this course is to build up further on the acquired basics of English Language The syllabus aims to enrich the essential nuances of English grammar, vocabulary, writing skills and comprehension.*

Credits: 02 **Semester: II** **L–T–P: 2–0–0**

Module No.	Contents	Teaching Hours
I	**Sentences and Functional Categories:** Subject, Object, Predicate **Writing Skill**: Developing narratives with the help of key words **Non-Finites: Gerund, infinitives, participle** **Conjunctions** **Simple, Compound and Complex Sentences** **Concord:** Subject-verb Agreement **Voice:** Active & Passive **Text:** 'Water' by C. V. Raman **Reading comprehension (Unseen)**	**16**
II	**Word Formation: Inflection, derivation, blending, compounding and clipping** **Punctuation** **Narration: Direct & Indirect** **Parallelism** **Text**: 'A Brief History of the Future' by Stephen Hawking **Correction of Errors:** Correction of Errors on the topics covered in both modules **Vocabulary: Words that go together** **Writing Skills**: Writing Applications to the university authorities Letters to editors **Reading comprehension (Unseen)** **Text:** 'The Last Leaf' by O' Henry	**14**

Recommended Reading:
Time Machine by H.G. Wells

References:
Course Handbook (Collection of Short Stories, One Act Play & Essays)
English Grammar in Use by Raymond Murphy, IV Edition, Cambridge University Press, UK
Making Sense of English by M. A. Yadugiri, Viva Books Pvt. Ltd., New Delhi
Living English Structure by W.S. Allen, Pearson India

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

- Demonstrate a use syntactically correct and effective English.
- Identify common errors of English Language and correct them.
- Evaluate, analyze, comprehend and discuss through textual reading and other reading materials.
- Get prepared to take the next stage of the course in the third semester.

BECG0001: ELECTRONICS ENGINEERING

Credits: 04 **L–T–P: 3–1-0**

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 nashel sky, "*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.

Outcomes:

CO1: To understand the basics of semiconductors and PN junction diodes with its characteristics.

CO2: Apply the basics of diodes to analyze rectifiers, clippers, clampers and voltage regulator circuits.

CO3: To understand the basic concepts of Bipolar Junction Transistor, Field Effect Transistor and MOSFET's with their characteristics.

CO4: Apply the basics of transistor to design and analyze DC biasing amplifier circuits.

CO5: To understand operations amplifier and its parameters. Design different application circuits such as adder, subtractor, integrator and differentiator.

CO6: Identify and 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.

BME G0001: 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 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

Reference Books:

- Nag P. K.: "*Engineering Thermodynamics*", TMH, and India.
- Yadav R.: "*Thermodynamics and Heat Engines*", Vol I & II (Sl Edition) Central Publishing House Allahabad.
- HajraChowdhary SK and HajraChowdhary AK "*Workshop Technology*" Media Promotors& Publishers.
- Raghuwanshi RS, "*Workshop Technology*" DhanpatRai and Sons, New Delhi.
- VaWylen G.J. &Sonnlog R.E.: "*Fundamentals of classical thermodynamics*", John Wiley & Sons, Inc. NY.
- WarkWenneth: "*Thermodynamics*", McGraw Hill book Co. NY.
- Joel R.: Basic Engineering "*Thermodynamic*"s, Addison Wesley.
- Chapman WAJ, "*Workshop Technology*" Part 1-3, Viva Books Pvt. Ltd. New Delhi.

Outcome: *At the end of the course the student will be able to:*

- *Understand the basic laws of thermodynamics and their applications in engineering.*
- *Understand the processes and operations of metal joining, fabrication & casting with applications.*
- *Develop basic know how and awareness of various manufacturing processes.*

BPHS0801: ENGINEERING PHYSICS LAB

Objective: *14 no. of experiments based on theoretical aspects are set in laboratory to give B.Tech Students a sound practical knowledge in fundamental and applied physics.*
Note: Any twelve experiments at least five from each group.

Credits: 01 **Semester II** **L–T–P: 0–0–2**

Module No.	Content
I	Group -A 1. To determine the wavelength of monochromatic light by Newton's rings. 2. To determine the wavelength of monochromatic light with the help of Fresnel's biprism. 3. To determine the specific rotation of cane sugar solution using polarimeter. 4. To determine the wavelength of spectral lines using plane transmission /diffraction grating. 5. To determine the wave length of laser light by diffraction grating method. 6. To verify Stefan's law by electrical method. 7. To determine high resistance by leakage method using digital D.C. microvoltmeter. Group – B 8. To determine the specific resistance of the material of a given wire using Carey Foster's bridge. 9. To study the variation of magnetic field along the axis of current carrying circular coil and then to estimate the radius of the coil. 10. To calibrate the given ammeter by potentiometer. 11. To calibrate the given voltmeter by potentiometer. 12. To study the Hall Effect and determine Hall coefficient, carrier density and mobility of a given semiconductor. 13. To determine the energy band gap of a given semiconductor material. 14. Measurement of resistivity of semiconductor by four probe method at different temperatures and determination of the band gap.

BELH 0802: ENGLISH LANGUAGE LAB II

Objective: *The objective of this course is to give students exposure of listening and speaking English in various communicative contexts. The course will also provide them with an opportunity to form their opinion, develop their thinking skills, analyze their thoughts and express themselves in an effective way, honing their communicative skills in English.*

Credit: 01 **Semester: II** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**Audio Visual Material for Listening and Speaking:** Speech by R. Madhavan at Harvard University: India in 2030 Debates: Tips & Samples 'One Crime History': Animated video Listening Comprehension: Sundar Pichai Situational Dialogues 'India on four wheels': A BBC documentary 'Extempore: Tips & Demo(Video) **Speaking Activities:** Discussion on India in 2030 Debate: A Class Activity Newspaper reading and discussion Extempore Discussion on problems of India & possible solutions Role Plays	16
II	**Audio Visual Material for Listening and Speaking:** Group Discussion' – Dos and Don'ts A Police Chief with a Difference' – TED Talk by Kiran Bedi Public Speaking Short Fiction: 'An Astrologer's Day' R K Narayan Exit level recording by students **Speaking Activities:** Group Discussion: A Class Activity Discussions on gender discrimination Presentations A Class Activity: Meet a Celebrity	**14**

Audio-Visual Material:

itell: Study Material of 'Orell' Digital Language Lab.

References:

1. Norman Lewis, *Word Power Made Easy*, Goyal Publications & Distributers, Delhi.
2. Mohan, Krishan & N.P. Singh, *Speaking English Effectively*, Macmillan India Ltd., New Delhi
3. *Cambridge English Pronouncing Dictionary* by Daniel Jones

Outcome:

After the completion of the course students will be able to:

- Listen, understand and analyse a variety of speeches, documentaries and interviews.
- Express themselves with correct pronunciation and fluency.
- Use appropriate vocabulary.
- Participate in discussions on social and professional issues.

BECG0800: ELECTRONICS LAB - I

Credits: 01 **L–T–P: 0–0-2**

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 &subtractor. 9. To study various logic gates such as OR, AND, NOT, NAND, NOR. 10. Realization of half adder &subtractor 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

Outcomes:

1. Evaluate the performance of PN junction diode, npn BJT and N-channel EMOSFET.
2. Analyse the operations of Rectifiers, clampers and clipper circuits
3. Verify the truth tables of basic gates (NOT, OR, AND) and universal gates (NAND, NOR).
4. Implement IC-741 of Op-Amp to analyse its applications as adder and subtractor.

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 **Semester I** **L–T–P: 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 and core. **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 metallic work-piece (M.S.) as per given dimensions. **(2)** To perform the operations of drilling of making the holes on the given metallic work-piece (M.S.) by use of Drilling machine. **(3)** To perform the operations of making internal threads by use of tapes and dies.	30

Outcome: *On successful completion of this lab, the students will be able to:*

- *Demonstrate an understanding of and comply with workshop safety regulations.*
- *Select and perform a range of machining operations to produce a given job.*
- *Identify and use marking out tools, hand-tools, and measuring equipments and to work to prescribed tolerances. Acquire knowledge of welding, joint design and the application of welding.*

Reference Books:

- *John K. C.; "Mechanical Workshop Practice"; PHI Learning Pvt. Ltd., New Delhi*

- *Choudhary Hajra; "Elements of Workshop Technology"; Media Promoters & Publishers Pvt. Ltd., Mumbai*

BTBC 0801: ANIMAL AND PLANT PHYSIOLOGY LAB

Credits: 02 **Semester II** **L–T–P: 3–1–0**

Module No.	Content	Lab Hours
I	• RBC & WBC count by Haemocytometer in blood • Prepares Slides: Historical slides of mammals of following organs- Stomach, Intestine, Liver, Pancreas, Kidney, Testis, Ovary and Spinal cord • Microscopic study of different tissues. • Estimationof haemoglobin in blood, Determination of bleeding time, clotting time. • To demonstrate Osmosis with the help of Potato Osmometer • To demonstrate the phenomenon of Plasmolysis • To demonstrate root pressure • To demonstrate that water moves up through the xylem of plant • To demonstrate the phenomenon of Diffusion • To demonstrate Transpiration phenomenon with belljar method • To demonstrate the Stomatal transpiration by using four leaves • To compare the Stomatal & Cuticular transpiration of leaves of different plants by Cobalt chloride method • To separate chlorophyll pigments by Paper & Column Chromatography	30

M.Sc. (MICROBIOLOGY & IMMUNOLOGY)
COURSE CURRICULUM

(w.e.f. Session 2020-21)

INSTITUTE OF APPLIED SCIENCES & HUMANITIES

Table of Contents

COURSE STRUCTURE

M.Sc.

(MICROBIOLOGY & IMMUNOLOGY)

First Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVE	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSMC 0001	General Microbiology	Core	4	0	0	4	4
2.	MMAS 0501	Advanced Biostatistics	GE	3	1	0	4	4
3.	MSBC 0001	Biochemistry	Core	4	0	0	4	4
4.	MSBC 0004	Biophysical Techniques	Core	4	0	0	4	4
5.	MSBC 0003	Bioinformatics	Core	4	0	0	4	4
PRACTICALS								
6.	MSMC 0801	General Microbiology & Biostatistics Lab	Core	0	0	3	2	3
7.	MSMC 0802	Biochemistry & Biophysical Techniques Lab	Core	0	0	3	2	3
8.	MSBC 0802	Bioinformatics Lab	Core	0	0	3	2	3
Total				**19**	**1**	**9**	**26**	**29**

Second Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVE	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSMC 0002	Systemic Bacteriology and Mycology	Core	4	0	0	4	4
2.	MSMC 0003	Systemic Virology	Core	4	0	0	4	4
3.	MSBC 0005	Immunology	Core	4	0	0	4	4
4.	MSBC 0006	Genetics & Molecular Biology	Core	4	0	0	4	4
5.	BELH 0012	Introduction to Gender and Womens studies	GE	4	0	0	4	4
PRACTICALS								
6.	MSMC 0803	Bacteriology & Mycology Lab	Core	0	0	3	2	3
7.	MSBC 0805	Immunology Lab	Core	0	0	3	2	3
8.	MSMC 0804	Genetics, Molecular Biology and Virology Lab	Core	0	0	3	2	3
Total				**20**	**0**	**9**	**26**	**29**

Third Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVE	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSMC 0004	Fermentation Technology and Industrial Microbiology	Core	4	0	0	4	4
2.	MSMC 0005	Food, Dairy and Agricultural Microbiology	Core	4	0	0	4	4
3.	MSBC 0011	RDT, Genomics & Proteomics	Core	4	0	0	4	4
4.	MSMC 0006	Advanced Immunology	Core	4	0	0	4	4
Electives (Select any Two)								
5.	MSME 0001	Environmenmental Microbiology	Elective	4	0	0	4	4
6.	MSBE 0001	Nanobiotechnology	Elective	4	0	0	4	4
7.	MSBE 0002	Enzyme Technology	Elective	4	0	0	4	4
8	MSBE 0003	Clinical Research in Medicinal Plants	Elective	4	0	0	4	4
9	MSME 0002	Animal Cell Culture	Elective	4	0	0	4	4
Electives (Select any One)								
10	MSBE 0005	Nutritional Biochemistry	Elective	4	0	0	4	4
11	MSBE 0006	Drug Discovery and Development	Elective	4	0	0	4	4
12	MSBE 0007	IPR, Patent, Trademarks & Bioethics	Elective	4	0	0	4	4
PRACTICALS								
13.	MSMC 0805	Fermentation Technology, RDT & Genomics & Proteomics Lab	Core	0	0	3	2	3
14.	MSMC 0806	Food, Dairy, Agricultural Microbiology & Advanced Immunology Lab	Core	0	0	3	2	3
PRACTICALS BASED ON ELECTIVES (Select any Two)								
15.	MSME 0801	Environmental Microbiology Lab	Elective	0	0	3	2	3
16.	MSBE 0801	Nanobiotechnology Lab	Elective	0	0	3	2	3
17.	MSBE 0802	Enzyme Technology Lab	Elective	0	0	3	2	3
18.	MSBE 0803	Clinical Research in Medicinal Plants Lab	Elective	0	0	3	2	3
19	MSME 0802	Animal Cell Culture Lab	Elective	0	0	3	2	3
Total				**28**	**0**	**12**	**36**	**40**

Fourth Semester

S. NO.	CODE	SUBJECT	CORE/ ELECTIVE	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSMJ0971	Project Work (Six Months)		0	0	0	16	-
Total				**0**	**0**	**0**	**16**	**-**

S. No.	Category	Subject	Credit	Total Credits
1	Core (Theory)	12	4	48
2	Core (Practical)	8	2	16
3	GE	2	4	8
4	Electives (Theory)	2	4	8
5	Electives (Practicals)	2	2	4
6	Elective	1	4	4
7	Project	1	16	16
8	Total Credits			104

SYLLABUS

M.Sc.

(MICROBIOLOGY & IMMUNOLOGY)

MSMC 0001 : GENERAL MICROBIOLOGY

COURSE OBJECTIVES: Since microbes are ubiquitous and play role in most of spheres in the universe. Discuss about the historical concept of spontaneous generation and how Koch's postulates are used to establish the causal link between a suspected microorganism and a disease and describe some of the various activities of microorganisms that are beneficial to humans.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Overview of Microbiology and its significance. Classification of bacteria, General characters of Archaebacteria, General characters of Cyanobacteria; Their ultrastructure, reproduction and economic importance. Prokaryotic Cell - Ultrastructure and Characteristics of Prokaryotic Cell. Morphology of bacteria, bacterial cell wall, Archaeal cell walls, Cell membrane, Cytoplasmic matrix, The nucleoid, Extra chromosomal nuclear material, Intra cytoplasmic structures, Protein secretion in prokaryotes, Structures external to the cell wall (flagella, fimbrae and pili)- structure and functions. Sterilization and Disinfection – Definitions, Physical and chemical methods. Culture media- Definition, Preparation and their types. Culture Preservation and Maintenance – Freeze drying (lyophilization, liquid nitrogen, storage at -70^{0}C, gelatin discs, mineral oil, sub-culturing etc.) Microbial Nutrition, Growth and Metabolism - Common nutrient requirements, Nutrient based classification of Microorganisms, Growth factors, Growth curve, Continuous and batch culture of microorganisms. Uptake of nutrients by the bacterial cell. Peptidoglycan synthesis. Eukaryotic Cell – The evolution of eukaryotes, Ultrastructure and Characteristics of Eukaryotic Cell. Flagella and cilia. The cell wall and Glycocalyx, The Plasma membrane, cytoplasm, Cell orgenelles – Golgi complex, Lysosomes, Vacoules, Mitochondria, Chloroplast, Peroxisomes, Centrosome.	18
II	General characteristics of fungi, Classification of fungi of medical importance (by Alexopoulos), Economic importance of fungi. Mutalism and symbiosis with plants and animals. Heterothallism, parasexuality, sex hormones in fungi. Diversity of endo and ecto mycorrhizal fungi. Biology of arbuscular mycorrhizal fungi: penetration and colonization inside roots, culturing and benefits, recent advances in the field of mycorrhiza.	24

	General characteristics of algae, Classification of algae (by Frisch), Economic importance of algae. Algae and biofuel, Origin and evolution of sex in Algae. Structure and reproduction of *Volvox, and Sargassam*. Brief outline on discovery of virus, terms & definition of virology, nomenclature and classification of viruses, distinctive properties of viruses, morphology, symmetry and ultrastructure of viruses including bacteriophages. Pathogenesis of Microbes- Pathogenesis of microorganisms, Host-parasite relationships, pathogenesis of bacterial infection Toxigenecity (Exotoxin and Endotoxins, mechanism of action of bacterial toxins), Host defense against microbial invasion, Microbial mechanisms for escaping host defenses. Antimicrobial Therapy- Development of chemotherapy, General Characteristics of antimicrobial drugs, Antibacterial and Antifungal drugs, Drug Resistence.	

Text Book:

- M.J. Pelezar, E.C.S.Chan N.R.Krieg, "Microbiology": McGraw Hill Education, 2001.

Reference Books:

- G.J Tortora, B.R., Funke, C.L. Case, "Microbiology- An Introduction": Pearson Publication, 2016.
- R. Stainer, J. Ingharam, M. Wheelis and P. Painter, "General Microbiology": Palgrave Macmillan, 2003.
- Presscott, Herley and Klein, "Microbiology": McGraw-Hill Science, 2007.
- R.C. Dubey and D. K. Maheshwari, "Textbook of Microbiology": S. Chand Publication, 2010.

Focus: This course focus on skill development aligned with CO1 & CO2

Course Outcome: After completion of this course student will able to

CO1- Identify the major categories of microorganisms and analyze their classification, diversity, and ubiquity.

CO2- Help students understand history, biology of microorganisms, growth and control of microbes.

CO3- Thus the beginners are rightly exposed to foundation of Microbiology which would lead them towards progressive advancement of the subject.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO1, PSO2
CO2	PO1, PO3, PO5, PO7, PO8/PSO2, PSO4
CO3	PO2, PO4, PO5, PO6, PO8/PSO1, PSO3

MMAS 0501: ADVANCED BIOSTATISTICS

OBJECTIVES: To make the students understand the advanced concepts of biostatistics, algebra and differential equations.

Credits: 04 **Semester** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	Introduction to Vector algebra, Scalar & Vector triple products, Collinear and Coplanar vectors, Determinant and its properties, Adjoint and Inverse of a matrix (simple problems), Formation of ordinary differential equations (ODEs), Solution of ODE of I order and I degree (Variable separable and Linear forms only). Introduction to Biostatistics, Revision of measures of central tendency and dispersion,	18
II	Computation of moments, Skewness and Kurtosis by the method of moments, Introduction to probability, Additive and multiplicative laws, Conditional probability. Method of least squares for fitting of exponential curves, Sampling, Testing of hypothesis, Type I and type II errors, Level of Significance, Degree of freedom, Students' t-test, F–test, Chi-square test as a goodness of fit and as a test of independence, ANOVA (one way classification).	24

Text Books:

- P. Banerjee, Introduction to Biostatistics, S. Chand & Co., Delhi, 2006.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- H. Kishan, Differential Equations, Atlantic Publishers and Distributors, Delhi, 2008.

Reference Books:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- B. K. Mahajan, Methods in Biostatistics, Jaypee Brothers Pub., New Delhi, 2010.

Focus: This course focus on skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To recognize and give example of different type of data arising in public health and clinical studies.

CO2- To interpret difference in data.

CO3- To select an appropriate test for comparing populations.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO1, PSO2
CO2	PO1, PO2, PO4/PSO1
CO3	PO1, PO6, PO7,PO8/PSO2

MSBC 0001: BIOCHEMISTRY

COURSE OBJECTIVES: The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of lecture series.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	*Carbohydrates* **Glycolysis**: definition, location, reactions, stoichiometry, fate of pyruvate, ATP production, energetics of Glycolysis, regulation **Kreb's cycle:** definition, location, pyruvate dehydrogenase enzyme complex, reactions, stoichiometry, amphibolic nature, energetics of TCA cycle, regulatio, Mitochondrial electron transport and oxidative phosphorylation. Anaerobic respiration in bacteria. **Alternative pathways of Carbohydrate metabolism:** pentose phosphate pathway (function, location, reactions, stoichiometry, regulation), uronic acid pathway, metabolism of fructose, metabolism of lactose, metabolism of amino sugars *Amino acids* **Biosynthesis of amino acids:** biosynthesis of alanine, aspartate, asparagine, glutamate, glutamine, arginine, proline, serine, glycine, cysteine, tyrosine, feed back regulation of amino acid biosynthesis. **Amino acid degradation:** transamination, oxidative deamination, conversion of alanine, serine and cysteine into pyruvate, conversion of aspartate and asparagines into oxaloacetate, conversion of glutamine, histidine, arginine, proline into α- ketoglutarate through glutamate, conversion of methionine, isoleucine, valine into succinyl-CoA, catabolism of phenylalanine, tyrosine and tryptophan	18
II	*Lipids* **Biosynthesis of fatty acids:** formation of malonyl CoA, fatty acid synthase complex, reactions of fatty acid synthase, elongation of fatty acid chains, regulation of fatty acid biosynthesis. **Fatty acid oxidation:** activation of fatty acids, role of carnitine in transport of long chain fatty acid, β oxidation of saturated and unsaturated fatty acids, oxidation of odd chain fatty acids, regulation of fatty acid oxidation *Nucleic acids* **Biosynthesis of Purine and Pyrimidine Nucleotide:** De novo synthesis of purine nucleotides, regulation of De novo synthesis of purine nucleotides, salvage pathway for purine nucleotides, De novo synthesis of pyrimidine nucleotides, regulation of pyrimidine synthesis, salvage pathway for pyrimidine nucleotides, formation of deoxy ribonucleotides Degradation of Purine and Pyrimidine nucleotides. **Inborn errors of metabolism:**Protein- PKU, Alkaptonuria, Maple syrup & Gauchers disease Carbohydrates: glycogen storage disorders, Cori's disease & Pomes disease Lipids- Atherosclerosis. Nucleic acids- Gout, Lesch-Nyhan syndrome, Sickle cell anaemia	24

Text Book:

- J.L. Jain, S. Jain and N. Jain, "Fundamental of Biochemistry": S. Chand & Company Pvt. Ltd, 2016

Reference Books:

- J. M. Berg, L. Stryer, J. L Tymoczko and G.J. Gatto, "Biochemistry" : W.H. Freeman, 2015
- D.L. Nelson and M. Cox, "LehningerPrinciples of Biochemistry" : W.H. Freeman,
- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

Focus: This course focus on employability aligned with all CO1 & CO2

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

CO1- Describe the Metabolism of carbohydrates, lipids and its regulation.
CO2- Describe the metabolism of amino acids, nucleic acids and its regulation.
CO3- Understand the concept of inborn errors of metabolism.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO7/PSO1, PSO2
CO2	PO2, PO4, PO5, PO8/PSO1, PSO2
CO3	PO1, PO3, PO5, PO6, PO8/PSO1, PSO2

MSBC 0004: BIOPHYSICAL TECHNIQUES

OBJECTIVES: To provide scientific understanding of analytical techniques and detail interpretation of results.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• **Microscopic techniques**: Principle of light microscopy, Phase contrast microscopy, Fluorescence microscopy, Scanning and Transmission Electron Microscopy, Staining procedures in light and Electron microscope, Confocal microscopy, Atomic force microscopy • Centrifugation: Principle, RCF, Rate Zonal and isopycnic density gradient centrifugation, Preparative and analytical ultracentrifuges, molecular weight determination, sedimentation analysis • **Chromatography techniques:** TLC, Gel filtration chromatography, Ion –Exchange chromatography, Affinity chromatography, Tandom affinity purification, Gas-liquid chromatography, HPLC	18
II	• **Electrophoresis techniques:** Principle and application of PAGE, SDS-PAGE, Iso-electric focusing, 2D electrophoresis, Agarose gel electrophoresis, Pulse Field Gel Electrophoresis, Orthogonal field alteration gel electrophoresis, Southern, Northern and Western blotting. • **Spectroscopic techniques:** Principle and application of UV, Visible and IR spectroscopy, Fourier transform IR spectroscopy, Fluorescence spectroscopy, ESR, NMR, Atomic absorption spectroscopy, Mass spectroscopy, Raman spectroscopy, ORD and CD spectroscopy, X-ray crystallography, Flow cytometry	24

Text Book:

- Biological Instrumentation & Methodology by Bajpai, P.K

Reference Books:

- Principle and Techniques in Biochemistryand Mol. Biology, by Keth, Wilson and Walker.
- Protein Purification Principle and Practices by Scopes, Robert K.
- Tools in Biochemistry David Cooper.
- Methods of Protein and Nucleic acid Research, OstermanVol I – III.
- Principle of Instrumentation analysis by Skoog& West.
- Biophysical Chemistry by Upadhyay&Nath.
- Physical Biochemistry: Application to Biochemistry and Molecular Biology by Freilder.

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To assimilate the principles and applications of centrifuge, electrophoresis and chromatography in research and related experiments so as to get placed in different diagnostic company.
CO2- Students could amalgamate classical analytical chemical techniques with modern technologies of manufacturing and analysis

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

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4, PO7/PSO1, PSO2
CO2	PO1,PO5, PO6, PO7, PO8/PSO1, PSO2

MSBC 0003: BIOINFORMATICS

OBJECTIVES: To expose students with essential elements of bioinformatics, viz. structural bioinformatics, functional bioinformatics, database searching and scope of various biological databases in life science research.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Biological Databases** Nucleotide databases at NCBI (GenBank, ESTs, SNP, UniGene, STS, RefSeq), File Formats, Access to Information via Entrez Gene at NCBI, Other databases: PubMed, OMIM, Taxonomy Chemical classification of amino acids, Principles of protein structure (Primary, Secondary, Tertiary and Quaternary), dihedral angle (ψ and φ), Ramachandran Plot, Protein database: UniProt), and Taxonomic System for Protein Structure: SCOP, CATH, Structural Databases (PDB, MMDB) **Techniques in Bioinformatics** Sequence Alignment: Global Alignment vs. Local Alignment, Dynamic Programming, and Concept of amino acids scoring matrices in Alignment: Dayhoff PAM matrices, BLOSUM Matrices,	14 18
II	Database similarity searching: BLAST, psi BALST Multiple Sequence Alignment: Star Alignment Heuristics, Applications of MSA: PSSM, Profiles, HMM. **Structural and Functional Bioinformatics** Identification of Protein Motif and Domain using MSA, Motif databases: PROSITE, PRINT, BLOCKS, InterPro, and Protein Tertiary Structure Prediction: homology modeling, Threading & Fold recognition, ab intio, Introduction to Microarray technology (Affymatrix, Agilent, cDNA), Text Mining for information extraction from Biomedical Literature	24

Text Book:

- Bioinformatics: Principles & Application by Zhumur, Ghosh

Reference Books:

- Computational Methods in Biotechnology – Salzberg S. L. et al., Elsevier Science.
- Statistical Methods in Bioinformatics-Evens & Grants, Springer-Verlag, NY.
- Computational Molecular Biology- Setubal and Meidanis, PWS publishing Co.
- Protein Structure Prediction-A Practical Approach, MJE Sternberg, Oxford University Press.
- Purifing Protein for Protemics, Richard J. Sinpson, I.K. International Pvt. Ltd.

Focus: This course focus on employability and skill development aligned with all CO1&CO2

Course Outcomes: After completion of this course, the students will be able:

CO1- To acquaint fundamental knowledge of bioinformatics tools.

CO2- To learn techniques effectively how to utilize these resources in life science research so they get employable in the domain of computational biology and insilico

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4, PO7/PSO1, PSO2
CO2	PO2, PO4, PO5, PO8/PSO1, PSO2

MSMC 0801: GENERAL MICROBIOLOGY & BIOSTATISTICS LAB

COURSE OBJECTIVES:

The main objective of this course is to well verse the students with practical knowledge of Microbiology that they have taught in the theory and provide hands on training on practical techniques of Microbiology related practical.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Safety rules for working in microbiology lab. • Washing of glassware. • Preparation of culture media. • Isolation of bacteria from soil, air and water. • Enumeration of bacterial colonies by serial dilution and plating. • Simple and differential staining. • Special staining technique. • Determination of antibiotic sensitivity test • Cultivation of moulds and other fungi..	30

Focus: This course focus on employability, skill development aligned with CO1& CO2

Course outcomes: After completion of this course, the students will be able:

CO1- To observe the morphology of bacteria by using different staining techniques to get employable in various industry utilizing microbes in down streaming process for commercial production of valuable and useful products

CO2- To expertise handling culturing the bacteria and fungi in –vitro.

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

COs	POs/ PSOs
CO1	PO2,PO3, PO4, PO5, PO7 /PSO1,PSO2
CO2	PO1,PO4, PO6, PO7,PO8 /PSO1, PSO2

MSMC 0802: BIOCHEMISTRY & BIOPHYSICAL TECHNIQUES LAB

COURSE OBJECTIVES: Biophysical techniques form the basis for all aspects of modern Biotechnology. The objective of the course is to advance the student's knowledge of spectroscopic, electrophoresis, chromatographic techniques and other current biophysical methods.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• To carry out preparation of Buffer: Acetate Buffer • To carry out qualitative analysis of Carbohydrates • To carry out qualitative analysis of Lipids • To carry out qualitative analysis of amino acids • To carry out qualitative analysis of Proteins • Determination of Blood Group • To carry out estimation of carbohydrate by Anthrone method • To carry out estimation of DNA by Diphenylamine method • To carry out estimation of RNA by Orcinol method • To carry out estimation of protein by Biuret method • To carry out estimation of protein by Folin- Lowry's method • To carry out estimation of cholesterol in blood serum • To describe the different parts of compound microscope with their fuction. • Separation of lymphocytes by density gradient centrifugation. • To carry out separation of amino acid by Paper Chromatography & determination of Rf value • TLC of fatty acids/lipids • Separation of proteins by PAGE, SDS- PAGE • Agarose gel electrophoresis of nucleic acids • Immunoelectrophoresis, Agar gel diffusion, counter immuno electrophoresis. • Verification of Beer Lambert law with the U.V. spectrophotometer.	30

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To understand basic fundamental concept of metabolism

CO2- Describe the qualitative analysis of carbohydrates, lipids, protein and nucleic acid

CO3- To understand the quantitative analysis of carbohydrates, lipids, protein, nucleic acid and cholesterol so as to get placement in diagnostic and pathological field

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

COs	POs/ PSOs
CO1	PO2,PO4, PO5, PO7 /PSO2
CO2	PO1,PO4, PO6, PO7,PO8 /PSO1, PSO2
CO3	PO1,PO4, PO5, PO8 /PSO1

MSBC 0802: BIOINFORMATICS LAB

OBJECTIVES:

Practical are designed to inculcate skill-sets in students to navigate biological databases and utilize bioinformatics software and ascertain them computational possibilities in biotechnology/microbiology.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Database searching against a query sequence and selection of orthologous sequences • using BLAST • Multiple Sequence Alignment using Clustal W • Prediction of Open Reading Frames using ORF Finder • 3 Dimensional Structure of protein using Deep View • Phylogenetic Analysis using Phylip (Neighbor Joining and Maximum Likelihood) • Bio programming using Practical Extraction and Reporting Language (PERL)	15

Focus: This course focus on employability and skill development aligned with all CO1 & CO2

Course Outcomes: After completion of this course, the students will be able:

CO1- To use tools and techniques of bioinformatics effectively to get positions in the area of computational biology

CO2- To apply bioinformatics applications efficiently.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO4, PO5, PO7, PO8 /PSO2
CO2	PO1,PO4, PO6, PO7,PO8 /PSO1, PSO2

MSMC 0002: SYSTEMIC BACTERIOLOGY & MYCOLOGY

COURSE OBJECTIVES: To study about the microorganisms associated with infectious diseases, including the bacteria, fungi, and protozoa's. Emphasizes the health care aspects and the distribution and activities of microbes as related to the following: microbial nutrition and anatomy, growth, disease, epidemiology, infection and immunity.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Pathogenesis of bacterial pathogens- Identification of disease causing bacteria, transmission of bacterial infection, innfectious process, genomics and bacterial pathogenecity, bacterial virulence factors, regulation of bacterial virulence factors, Immune response to bacterial infections. Norormal Human Microbiota and Its Role- Normal microbiota of the skin, normal microbiota of the mouth and upper respiratory tract, normal microbiota of the intestinal tract, normal microbiota of urethra, normal microbiota of vagina, normal microbiota of conjuctiva. Morphology, cultural and biochemical characteristics, virulence factors, antigenic structure, patogenesis laboratory diagnosis and prophylaxis of important bacterial pathogens - Staphylococcus, Streptococcus, Escherichia coli, Salmonella, Shigella, Pseudomonas, Vibrio, Corynibacterium, Bordetella, Bacillus, Clostridium, Listeria, Yersenia, Tryponema, Helicobacter, Mycoplasmsma, Chlamydia Leptospira.	18
II	Classification of fungal diseases, General introduction, morphology, pathogenesis, laboratory diagnosis and treatment of *Dermatophytes, Aspergellosis, Candidosis, Chromoblastomycosis, Cryptococosis, Blasomycosis and Coccidiodomycosis.* Immune response to fungal infections. General introduction, morphology, pathogenesis, laboratory diagnosis and treatment of *Girardia lamblia, Entamoeba histolytica, Cryptosporidium, Plasmodium and Toxoplasma.* Immune response to protozoal infections.	24

Text Book:

- R. Ananthanarayan and C. K. Jayaram Paniker, "Textbook of Microbiology", Universities Press (India) Pvt. Ltd. Eleventh edition, 2020.
- W. W. C. Topley, Sir Graham S. Wilson, M.T. Parker, L.H. Collier, "Text book on principles of bacteriology, virology and immunology": IX edition (5 volumes), Edward, London, 1995.

Reference Books:

- G. J. Tortora and B. R. Funke and C. L Case, "Microbiology: An Introduction" Pearson Publication, 11 Edition, 2016.

Focus: This course focus on employability aligned with all CO2 & CO3

Course outcomes: After completion of this course, students will able to

CO1- Demonstrate and evaluate the interactions between microbes and humans and factors that may contribute to disease.

CO2- Identify and evaluate microbial diseases: their causative agent, source (or vector), reservoir, epidemiology, mode of transmission.

CO3-Identify and evaluate microbial diseases: their pathogenesis, symptoms, diagnosis, prevention, control, treatment, and applicable clinical isolation precautions

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

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO7, PO8 /PSO2, PSO3
CO2	PO2,PO4, PO5, PO7 /PSO1, PSO4
CO3	PO1,PO2, PO5, PO6, PO8 /PSO1, PSO2, PSO4

MSMC 0003: SYSTEMIC VIROLOGY

COURSE OBJECTIVES: The course is aimed to make bio students aware about importance of viruses in field of medicine, molecular biology and cancer.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Over view of Virology: Reasons for studying virology, Disease causing agents in humans animals plants. Usefulness of viruses Contributions of virus in molecular biology, cell biology and cancer. viroids and prions, Methods used in virology Isolation and cultivation of virus, centrifugation, Microscopy, X-Ray crystallography and electrophoretic techniques detection of viruses and viral components electron microscopy Detection of infectivity using cell culture Detection of virus antigen Detection of virus nucleic acids: Hybridization, PCR Criteria of classification and classification of viruses, pathogenesis modes of Transmission Antiviral agents. Brief Account of morphology, cultivation, antigenic structure, pathogenesis, laboratory diagnosis and prophylaxis of RNA virus families- Picornaviridae (Polio virus), Reoviridae (Reovirus and Rotavirus), Togaviridae (Yellow fever virus), Orthomyxoviridae (Influenza virus), Paramymyxoviridae (mumps, measles & Rubella virus), coronaviridae (Coronavirus), Rhabdoviridae (Rabies virus), and Retroviridae (AIDS & Lenti virus), Bunyaviridae and Hepatitis virus.	18
II	Infectivity Assays- Quantitative assays, Quantal assays one step growth, Virus Genetics Brief Account of morphology, cultivation, antigenic structure, pathogenesis, laboratory diagnosis and prophylaxis of DNA virus families- Parvoviridae (Parvovirus), Adenoviridae (Adenovirus), Herpesviridae (Herpes simplex virus and vercilla zoster virus), Poxviridae (Poxvirus) and Hepadnaviridae (Hepatitis-B virus). Plant Viruses: Methods of Assay of Plant Viruses, Biology and Mode of Trnasmission of Plant Viruses, Discussion on some of the Important Plant Diseases Caused by Viruses and their Control: Tobacco Mosaic Virus (TMV - Symptoms, Viral Structure Protein Synthesis, Transmission); Potyvirus Group (Potato Virus Y), Cauliflower Mosaic Virus.	24

Text Book:

- Text book on principles of bacteriology, virology and immunology, IX edition (5 volumes), Edward, London by Topley and Wilson.

Reference Books:

- Microbiology: Davis, B. D.; Delbecco, R.; Eisen, H.N.; Ginsberg, H.S., by Haper & Row.
- Medical Microbiology : Greenwood, D, Slack, R. C. B., Pleutherer, 1. F., Churchill Livingstone.
- Virology : Principles and applications, John B. Carter and Venetia A. Saunders WILEY
- Animal Virology: Frank and Fennar

Focus: This course focus on employability aligned with CO1

Outcome: The major outcome of this course are-

CO1- To generate manpower through post graduate level teaching program on novel approaches to tackle major communicable and emerging diseases problems at national and global level and get position in health sectors.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO4, PO6, PO7, PO8 /PSO2, PSO3, PSO4

MSBC 0005: IMMUNOLOGY

OBJECTIVES: To learn about the structural and functional features of the components of the immune system and emphasis will be on the mechanisms involved in immune system, development and responsiveness.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Overview and importance of Immunology. • Cells and organs involved in immune system. • B cell development. • T cell development • Molecules communicating among cells of immune system their receptors & signaling. • **Innate immunity (Nonspecific defense mechanism) –**Definition, Ubiquity, Innate defensive barriers, (Anatomical, Physiochemical and cellular) phgocytosis and inflammation, Generation of anti microbial mechanisms, Receptors (TLR, Scavenge receptor etc.) of the innate immunity, Signal transduction pathways in activation of innate immunity, Link between Innate and adaptive immunity. • **Adaptive immunity (Specific defense mechanism)-** Definition, Types of adaptive immunity, Attributes, Antigen (Immunogen) Haptens Definition, properties and types, Factors affecting antigencity, Epitopes recognized by B and T lymphocytes, Adjuvants, examples and mechanisms in enhancing antigenecity. • **Immunoglobulins-** Definition, Basic structure, classes and subclasses, Physico-chemical and biological properties, Antigenic determinants on immunoglobulins, Functions of Fab and FC portion of ig : Enhancement of phagocytasis (opsonization), Activation of complement, Killing of target cell by ADCC, Transcytosis, Chemical vignette, Monoclonal and genetically engineered antibodies. Organisation of immunoglobulin genes, Mechanisms for generating regulation of Antibody Diversity. • Class switching. • Immunoglobulin gene super family.	18

II	• Antigen - Antibody interactions, General properties of Ag-Ab interaction, Importance in host and in laboratory, Principles and applications of in invitro Ag.Ab interactions, Different types of serological tests (Precipitation, Agglutination, CFT, Immunofluorescence, RIA, ELISA, Flowcytometry). • **The major histocompatibility complex (MHC)-** Structure and functions of MHC molecules, Organisation of MHC genes & MHC molecules, expression patterns, The endogenous pathway of antigen processing and presentation, The Exogenous pathway of antigen processing and presentation, Self –MHC restriction, Presentation of non peptide antigen. • **Immunomediated disorders-** • **Hypersensitivity and Allergy –** Definition, Classification, Distinguishing Features of Immediate and Delayed Hypersensitivity, IgE Mediated Hypersensitivity (Type I), Method used for Detection, Anaphylactic Reaction. Antibody Mediated Cytotoxicity (Type II) Hyper Sensitivity, Mechanism and Examples, Immune Complex (Type III) Hypersensitivity: Localized and Generalized Type III Reactions, Mechanism, Anybody Mediated Cell Stimulation (Type V) Hypersensitivity. Mechanism, Delayed (Type IV) Hypersensitivity Mechanism and Important Aspect in Diagnosis of Diseases • **Immuno Tolerance, Auto Immunity and immuno deficiency.** • **Vaccines and Toxoids** o Inactivated and Live Attenuated Vaccines o Sub unit Vaccines (synthetic & recombinant) o Conjugate Vaccines, multi component vaccine o Recombinant Vector Vaccines o DNA Vaccines o Toxoids.	24

Text Book:

Immunology by Shetty, N

Reference Books:

- Immunology by Kuby (Free man publication)
- Essentials of immunology by Roitt (Blackwell scientific publication)
- Immunology by Benacera
- Infection & Immunity by John Playfair& Gregory Bancroft (Oxford university Press)
- Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
- Immunology by C. Fatima

Focus: This course focus on employability aligned with CO1 & CO2

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

CO1- Understand the ability of our defense mechanism to protect against invading pathogens in logical fashion.

CO2- Understand the mechanism of molecules communicating among cells of immune system their receptors & signaling assisting them to get position in the vaccine production company and immunodiagnostic area

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

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO6, PO7/PSO1,

MSBC 0006: GENETICS & MOLECULAR BIOLOGY

OBJECTIVES: Biomolecules are important constituents of organism, Molecular biology provides the knowledge of DNA , RNA and Proteins for the organization of life and their function in different vital concept of life.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Basics of genetics • Organization of Prokaryotic and Eukaryotic Genome. • DNA Replication machinery in Prokaryotes and Eukaryotes . Regulation of DNA replication. • DNA repair mechanism. • Transcription in prokaryotes and Eukaryotes, Reverse transcription. • RNA processing, and editing. Regulation of gene expression in prokaryotes: • Regulation of gene expression in eukaryotes: Activators, and Insulators, Chromatin Remodeling, Chemical Modifications of Histones: role of Histone Acetyl transferases, and Deacetylases, Signal Transduction and control of transcriptional regulation, microRNAs and their role in gene expression regulation • Genetic Code: Evidence and properties; Wobble hypothesis; Transcriptional adaptors and amino acyl tRNA synthases	18
II	• Translation: Successive stages of protein synthesis in prokaryotes and eukaryotes • Protein degradation via proteasomes • Post-translational Modification: Types and Significance • Genetic recombination in prokaryotes and eukaryotes and its molecular mechanism. • Transposable elements in Prokaryotes and Eukaryotes: Types and Significance • Chromosomal and gene mutation • Introduction and application of Molecular markers (RFLP,AFLP.RAPD,SNP, and VNTR) • Biomedical Genetics & its application • Modern molecular Diagnostic techniques.	24

Text Book:

- Cell Biology, Genetics, Molecular Biology by Verma, P.S
- Molecular Biology by Friefelder, David

Reference Books:

- Albert B, Bray Denis et al.: Molecular Biology of The Cell.
- Watson, Hopkin, Roberts et al.: Molecular Biology of the Gene.
- Genetics- Strickberger.
- Microbial Genetics – D. Frifielder.
- Baltimore- Molecular Biology of the Cell.
- Benjamin Levin – Genes VIII.
- Advance Genetics by G.S. Miglani, Narosa Publishing House

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To provide the different concept of expression of genetic molecule DNA, RNA and proteins and their association with the genetic and physiological variation of higher and lower organism and how they are associated with each other and how their character inherited from generation to generation and get employable in Pharmaceutical industry

CO2- To learn how the Molecular biology is important in forensic science and get employable in forensic field

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

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2

BELH 0012: INTRODUCTION TO GENDER & WOMEN'S STUDIES

OBJECTIVES: An introductory course designed to introduce students to a variety of issues and disciplinary approaches to the study of women and gender. Classes will use audio-visual methods with oral presentations by students. Emphasis is given to the English language skills for oral communication and writing. Compulsory attendance. Limited enrolment for supervised learning.

EXPANDED DESCRIPTION: The question of gender is often a vexing one that has been important in shaping human experience and culture. We will explore how gender intersects with class, ethnicity, religion, age and other categories of experience. This course will focus primarily on gender and women's issues in the modern world. In addition to assigned readings from a range of texts, we will also attempt to examine representations of women and their condition in film and other media.

Themes: With a focus on issues of gender in domestic and workplace situations, the course will use the reading selections and multimedia materials to address a wide range of topical categories and themes, which will also be the base of students' Oral/Group Presentations:

Credits: 2 **Semester: II** **L-T-P: 2-0-0**

Module	Content	Teaching Hours
I	**Introduction** Becoming a Man or Woman: Emotions, Love, Beauty and the Media Women, Men & Sexuality: Gender & Human Bodies Modernity and Power: Institutions that Shape Our Lives Violence against Women: Domestic & Work Spaces Women and Violence: War and Terrorism	**12**
II	Health & Reproductive Freedom: Mothering and Parenting Differences among Us: Ageism, Racism and Prejudice **Review** Changing Our World: Culture, Society & Practice of Gender Sensitization Oral Presentations by Students	**18**

Recommended Reading:All materials will be available via email or online LMS (there are no course textbooks to purchase). Students will require access tothe internet and a computer.

Audio-Visual Material:Audio recordings will be made available via CDs and online.

References: Study-pack derived from *Women: images and realities. A multicultural anthology*.4th edition. Edited by Amy Kesselman, Lily D. McNair, NancySchniedewind. McGraw-Hill, 2007.

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

CO1- Identify important terms and concepts in the field of gender studies
CO2- Discuss the significance of important work done in this field
CO3- Discuss how different factors like age, ethnicity, race and culture impact human experiences
CO4- Discuss how women's studies and gender sensitization have led to revisions of cultural assumptions and practices regarding women
CO5- Relate gender concepts to our lived experiences
CO6- Be able to develop an oral presentation on a proposed project in some area of gender sensitization

Value Addition: Students will be able to connect, write and speak with confidence and clarity about their own responses to the selected readings and about gender and women's issues from multiple perspectives.

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

COs	**POs/ PSOs**
CO1	PO1, PO4, PO7, PO8 /PSO1, PSO2
CO2	PO2, po3, PO4, PO5, PO7, PO8 /PSO1
CO3	PO2, PO8 /PSO1, PSO2
CO4	PO1, PO2, PO8 /PSO2
CO5	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO6	PO2, PO5, PO7, /PSO1, PSO2

MSMC 0803: BACTERIOLOGY & MYCOLOGY LAB

COURSE OBJECTIVES:

The objective of this course is to well verse the students with practical knowledge of Bacteriology & Mycology that they have taught in the theory and provide hands on training on practical techniques of Bacteriology & Mycology related practical.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Safety guide lines follow in Bacteriology laboratory. • To study the morphology of bacteria. • To study the cultural characteristics of bacteria. • To Demonstrate the fermentation of different carbohydrate by bacteria. • To perform IMVIC test for the identification of bacteria. • Isolation of fungi from soil sample. • To identify the fungi by staining process. • Calibration and standardization of microscope by using ocular micrometer and stage micrometer. • Primary isolation of enteric pathogens *E. coli*, *Salmonella* and *Shigella*.. • Confermation of enteric pathogens *(E. coli*, *Salmonella* and *shigella)* by biochemical test. • Isolation and identification of bacteria from clinical specimens and their antibiogram.	30

Focus: This course focus on employability and skill development aligned with all COs

Course outcome: After completion of this course, student will able to

CO1- Understand different staining process

CO2- Understand methods of isolation and identification of bacteria from clinical specimen and get position in pharmaceutical industries.

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

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO3
CO2	PO1, PO2, PO4, PO5, PO7, PO8 /PSO1, PSO3, PSO4

MSBC 0805: IMMUNOLOGY LAB

COURSE OBJECTIVES:

The objective of this course is to well verse the students with practical knowledge of Bacteriology & Mycology that they have taught in the theory and provide hands on training on practical techniques of Bacteriology & Mycology related practical.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Handling of laboratory animals. • Routes of inoculation in lab animals. • Gel diffusion test- o Redial diffusion test. o Ouchterlany diffurion test. o Rocket electrophoresis. o Immuno electrophoresis. • Slide agglutination test. • Tube agglutination test / Passive agglutination. • ELISA Test.	30

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To handle the laboratory animals so as to get position in immuno-diagnostic field

CO2- To learn different antigen antibody reactions with isolation and identification of different kinds of bacteria with conceptualunderstanding of the subject.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO2, PO4, PO6, PO7, PO8 /PSO1

0804: GENETICS, MOLECULAR BIOLOGY AND VIROLOGY LAB

COURSE OBJECTIVE:

The objective of this course is well verse the students with the practical knowledge of genetics, molecular biology and virology that they have taught in theory and practical and provides hands on training.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Estimation of DNA content in the given sample by diphenylamine method. • (Nitrogen cylinders, -200C fridge, grinders, cooling centrifuges, etc.) • Estimation of RNA content by the Orcinol method. • Determination of Tm of DNA and RNA. • Isolation of Plasmid DNA. • Isolation of bacterial/fungal genomic DNA. • Isolation of plant DNA. • Purification of DNA through columns. • Restriction mapping of the DNA isolated from plant, bacteria and fungi. • Transformation of the bacterial cell. • PAGE OR Agarose gel electrophoresis of DNA • Cloning of genes in eukaryotic and prokaryotic vectors. • Haemagglutination test. • Haemagglutination inhibition test. • ELISA Test- o Indirect ELISA. o Sandwich ELISA. o Competetive ELISA. o ELISA Test. o Neutralization Test.	30

Focus: This course focus on employability and skill development aligned with all COs

Course outcomes: After completion of module, student will be able to

CO1- Perform different molecular techniques for isolation of DNA, RNA etc. and get position in pharmaceutical field

CO2- Perform various methods for demonstration and handling of virus and found positions in diagnostic domain

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

COs	POs/ PSOs
CO1	PO1, PO2, PO4 PO5, PO7, PO8 /PSO1, PSO2, PSO3
CO2	PO1, PO3, PO4, PO6, PO7, PO8 /PSO1, PSO2, PSO4

MSMC 0004: FERMENTATION TECHNOLOGY AND INDUSTRIAL MICROBIOLOGY

COURSE OBJECTIVES: The objective of the course is to help students attain a basic proficiency, role and application of biotechnology in the area of food and industrial processes.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Bioreactors: Principle, Kinetics, types, design, analysis and application.Types of fermentation processes: analysis of batch, Fed-batch and continuous Bioreactions, stability of microbial reactions. Aeration and Agitation systems for bioreactor.Flow behavior of fermentation fluids Gas-Liquid mass transfer, Solid and Liquid-phase mass transfer and Heat transfer. Measurement and control of bioprocess parameters. Production of Alcohols and Organic Acid : Alcohol Production - Malt-Beverages, Production of Beer, Production of Wines, Distilled Beverages or Liquors (Rum, Whiskeys, Brandy), Vinegar Production, Organic Acids - Citric, Lactic, Acetic, Propionic.	18
II	Production of Enzymes: Extracellular - Amylase.Protesases, Pectinases, Lipase, Cellulases, X ylanases, and Intracellular - Glucose Isomerase. Downstream processing, Immobilization of cell and Enzyme and their application. Vitamins - Vit B 12 and Riboflavin. Amino acids - Glutamic acid and Lysine. Production of Antibiotics : Antibiotics - β- Lactam (Penicillin and Cephalosporin), and Tetracyclines, Steptomycin, Polyenes (Nystatin), Aromatic (Griseofulvin). Microbial Transformations of Steroids or Sterols, Nonsteroid Compounds and Antibiotics. Single Cell Protein, Polysaccharides, Recombinant DNA Products Insulin, Somatostatin and Interferon.	24

Text Books:

- Principles of Fermentation Technology by Whilteker, A

Reference Books:

- Biochemical Engineering, Aiba*et al.*
- Biochemical Engineering Fundamentals, Baily and Ollis.
- Principles of Fermentation Technology by Stanebury P.F, and Whitaker.

- Fermentation Biotechnology-Principles, Process and Products by Ward,O.P.
- Process Engineering in Biotechnology, Jackson A.T.
- Bioreaction Engineering Principles, Nielson &Villadson.
- Industrial Microbiology by Prescott & Dunn.
- Microbial Biotechnology by Glazer &Nikaido.
- A Text Book of Industrial Microbiology by Cruger and Cruger.
- Manual of Industrial Microbiology & Biotechnology by Arnold *et al.*

Focus: This course focus on entrepreneurship and skill development aligned with all COs

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

CO1- Know about the production of primary and secondary metabolites production, handling and designing of different fermentor and bioreactors,

CO2- Know how the commercial production of wine, beer, processed food, recombinants products and antibiotics are controlled and utilized by human welfare.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO6, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO4, PO6, PO7, PO8 /PSO1, PSO2

MSMC 0005: FOOD, DAIRY AND AGRICULTURAL MICROBIOLOGY

COURSE OBJECTIVES: This course designed to introduce the essential fundamentals of Agriculture Microbiology. This course focuses on the concepts of Agricultural Microbiology such as Soil Environment, bacteria and viruses, bio pesticides & bio fertilizers and plant microbe-interactions. The Food Microbiology paper would enable students to learn about the epidemiology of food-borne diseases and the pathogens. Also, the study would equip them to study various methods of pathogen detection available along with understanding the beneficial and harmful effects of microbes in the food industry.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Food Spoilage: Spoilage of Cereals and Cereal Products, Fruits and Vegetables, Meat and Meat Products, Poultry and Eggs, Fish and Other Sea Foods, Milk and Milk Products, Beers and Wines, Fermented Foods and Canned Foods. Food Preservation: General Principal of Food Preservation, Aspesis, Removal, Anearobic Conditions, Low and High Temperature (pasturization, Sterilisation and Ultra High Temperature Treatment), and Drying./ Chemical Preservation of Food - Organic Acids and Their Salts, Propionates, Benzoate, Sorbate and Acetate, Nitrate, Nitrite, Sulphur Dioxide, Sulphides, Ethylene and Propiolene Oxides,Sugar and Salt, Alcohol. Benzoic Acid, Spices and Condiments. Preservation by Radiation. Fermented Food: Manufacture of Fermented Foods Like Dairy Products (Acidophilus Milk, Cheeses, Yoghurt, Kefir, Kumiss), Plant Product (Cocoa Beans, Coffee Beans, Pickels, Saur-kraut) Breads and Vineger.	18
II	Food Borne Diseases: Cholera, Stapylococcal Food Poisoning, Bacillus cereus Gastroenteritis, Botulism, Salmonellosis, Shigellosis, Typhoid Fever, Hepatitis-A, Poliomyelitis.Microbial Interaction: Ecological groups of microorganisms- Aututrophs and Heterotrophs; Psychrophiles, Mesophiles, Thermophiles, Hyperthermophiles. Soil Microorganisms, Aquatic Microorganisms, Air Microorganisms. Saprophytism, Parasitism, and Symbiosis. Antagonistic Interaction-Amensalism, Competition and Predation. Rhizosphere and Rhizoplane Microorganisms- Reasons for increased Microbial Activity in Rhizosphere, Composition of Root Exudates, Rhizosphere Microorganisms. Nitrogen Fixation (Symbiotic and Non Symbiotic), Node and Nodulins, Nitrogenase Enzyme, Nif Genes, Biofertilizers and microbial inoculants.	24

Text Books:

- Food Microbiology: Frazier, W. C. And Westhoff, D.C., Tata McGraw Hill Pvt. Co. Ltd.

Reference Books:

- Food Microbiology: James, J, CBS Publisher & Distributor, New Delhi. Comprehensive Dairy Microbiology: Yadav, J S., Grover, S. & Batish, V. K., S. Chand & Co., New Delhi
- Food Microbiology: ,Adams, M. R. And Moss, M. 0., New Age International (P) Ltd. Publishers, New Delhi.
- Soil Microorganisms & plant Growth: Subbarao, N. S., Oxford & IBH Publishing Co. Pvt. Ltd., New

Focus: This course focus on employability and skill development aligned with all COs

Course outcomes: After completion of this course student will be able to

CO1- Understand industrial application of microorganisms and recent microbial products.

CO2- Students will know the applied and industrial aspects of microbiology such as screening of microorganisms, strain improvement, microbial metabolites, fermented microbial products and microbial enzymes and get job in agriculture, health, dairy and food sector

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

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO4
CO2	PO1,PO2 PO3, PO4, PO5, PO6/ PSO2, PSO3, PSO4

MSBC 0011: RDT, GENOMICS & PROTEOMICS

COURSE OBJECTIVES: To expose students with recent advances in the field of Recombinant DNA Technology, and Genomics & Proteomics and their implication in life sciences research.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Tools used in GE** Principles of Gene Cloning, Enzymes used in RDT: Restriction Endonuclases, restriction digestion and restriction mapping, other DNA Manipulative enzymes, linkers and adaptors, Blunt end ligation Cloning vectors for E. coli: pBR322, pUC19, pGEM3Z, M13, Phagemids, Phage λ, Cosmid and BAC; Expression cassette, Transcriptional and Translational Fusion, limitations of recombinant protein production in prokaryotic host, Shuttle Vector, Cloning vectors for yeast : comparison of YEp, YIp and YRp, YAC **Techniques in GE** Gene and cDNA library, Molecular Probes, methods for clone identification: colony and plaque hybridization probing, Immunological detection methods, Polymerase Chain Reaction, PCR Primer designing, qPCR, site directed mutagenesis,	18
II	DNA Sequencing, Pyrosequencing, Sequencing by Synthesis (SBS) by Illumina, SOLiD™ **Genomics & Proteomics** Genome sequencing: Shot Gun, Clone Contig, Contig assembly by chromosomal walking, sequence tagged site; Genetic and Physical Mapping, Importance of map in sequence assembly Genome Annotation: identifying genes in a genome sequence, determining the function of an unknown gene Studying the transcriptome: Serial Analysis of gene Expression, Microarray Studying the Proteome: separation of proteins using 2D Gel, identification of individual protein using MALDI-TOF Studying protein-protein interactions: phage display, the yeast two hybrid system.	24

Text Book:

- Genetic Engineering by Rastogi, Samita

Reference Books:

- "Principles of Gene Manipulation" by R.W.Old and S.B.Primrose Third Edition Blackwell Scientific Publication
- "Gene Cloning " by T.A.Brown
- Molecular Biotechnology by Glick
- Expanding Horizons by B.D.Singh

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To acquaint theoretical understanding of genetic engineering tools and techniques, i.e. restriction digestion, blotting, map-based cloning, PCR etc. so as to get employable molecular diagnostic area

CO2-To learn how to exploit various ~omics technologies in biotechnology related activities.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO4, PO5, PO6/PSO1, PSO2

MSMC 0006: ADVANCED IMMUNOLOGY

COURSE OBJECTIVES: Understand the molecular and cellular basis of the immune system and integrate this knowledge into a framework by which to understand host defense to infection and microbial immune evasion strategies.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Transplantation Immunology:** • Graft rejection and immunologic principles • Specificity and memory in graft rejection • Transplantation Mltc antigens and blood groups • Clinical course during clinical course • Approaches to induce transplantation tolerance • Immune Responses to infections diseases (Bacteria, Fungal, viruses and protozoans). **Cancer Immunology:** • Terminology and types of cancer • Differences between normal and malignant cell • Malignant transformation of cell **Cancer associated genes:** Cancer promoting activity of oncogens, the relationship of proto-oncogens to oncogens, Cancer suppressor genes and Role of Apoptotic genes in cancer **Tumor antigens:** Tumor specific antigens, Tumor associated antigens	18
II	**Immune responses to cancer:** Immuno Surveillance, Immuno editing **Immuno eradication of cancer:** Innate and adaptive cells involved in cancer eradication, Antitumor Antibodies, role of cytokines **Cancer promoting immune reaction:** Inflammating responses, Anti tumor antibodies, Immunosuppression in tumor micro environment, Immuno evasion **Cancer immunotherapy:** • Cytokine based therapy • Monoclonal antibodies based therapy • Immunology in detection of cancer. **Vaccinology:** • Concept & scope and limitations of vaccines Evaluation of vaccines • Principles of vaccine Design and development • Strategies to vaccine design for stimulating innate immunity and mucosal immune system. • Selection of models in vaccine design	24

	• Sequence- Based computational approaches to vaccine discovery and design: Introduction, Designing vaccines based on alignments, Designing vaccines using epitope prediction • Antigen discovery for vaccines using high throughput proteomic screening technologies: Introduction, Synthetic proteomes, HT antibody screening, T-cell screening platforms, Strategies for identification of protective antigens, Future challenges.	

Text Book:

- Immunology by Shetty, N

Reference Books:

- Immunology by Kuby (Free man publication)
- Essentials of immunology by Roitt (Blackwell scientific publication)
- Immunology by Benacera
- Infection & Immunity by John Playfair & Gregory Bancroft (Oxford university Press)
- Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
- Immunology by C. Fatima

Focus: This course focus on employability aligned with CO2

Outcome: After completion of the course, students will be able:

CO1- This will also attempt to bring students up to date with current areas of basics research in immunology.

CO2- To understand concepts of cancer immunology and transplantation immunology so as to get placed in immuno-diagnostic fields

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2, PSO4

MSMO 0001: ENVIRONMENTAL MICROBIOLOGY

COURSE OBJECTIVES: One of the main objectives of study is the treatment and management of waste. In addition, concept, significance and application of micro-organisms for environmental cleaning.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Concept and significance of environmental microbiology. Microorganisms and Environment- Microbial diversity in normal environments, terrestrial (agricultural and desert soils), aquatic (fresh water and marine), atmospheric (stratosphere) and their potential applications. Microbes in extreme environment and their adaptation. Nutrient cycling process, carbon cycle, nitrogen cycle, sulphur cycle. Environmental Pollution and types. Role of microbes for safe and sustainable environment. Biodegradation and Biodeterioration, their economical impact. Liquid waste management: Treatment of sewage (Primary, Secondary and Tertiary treatments) and Treatment of Industrial effluents (distillery, textile, pulp and paper). Solid waste management: Waste types & their possible usages, landfill development and composting.	18
II	Bioremediation of environmental pollutants: Petroleum hydrocarbons and pesticides. Microbes and mineral recovery: Bioleaching of copper, gold and uranium. Desulphrisation of coal.Lignin degradation: Lignocellulolytic microorganisms, enzymes and their biotechnological applications. Biofertilizers- Nitrogen fixing and phosphate solubilizing biofertilizers. Microbial Insecticides- Bacterial, fungal and viral insecticides. Advances in Applied Bioremediation, their significant and applications for solving environmental pollution problems.	24

Text Book:

- Biotechnology . B.D.Singh.
- Microbiology. P.D. Sharma.

Reference Books:

- Waste water treatment for pollution control. Arceivala.
- Environmental Microbiology. R. M. Maier, I. L. Pepper & G. P. Gerba
- Comprehensive Biotechnology Vol. – 4. Murray Moo Young.
- Biotechnology. Rehm and Reid.
- Environmental chemistry. A.K.De, Wiley Eastern Ltd., New Delhi.
- Introduction to Biodeterioration. D.Allsopp and Seal, ELBS/ Edward Arnold.
- Environmental Biotechnologies and Cleaner Bioprocess by Eugenia J Olguuin et al.

- Environmental Science: Physical Principles and applications by Egbert Booker et al

Focus: This course focus on employability and skill development aligned with CO1 & CO2

Outcome: After completion of module student will be able to –

CO1- Understand contribution of microbes in environmental cleaning, microbial diversity, environmental pollution and types and get placed in biofertilizer, biopesticides and bioremediation industry

CO2-In addition the concept of advances in applied bioremediation, their significant and applications for solving environmental pollution.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2, PSO4
CO2	PO1, PO4, PO5, PO7, PO8 /PSO1, PSO3, PSO4

MSBO 0001: NANOBIOTECHNOLOGY

COURSE OBJECTIVES:

- The mission of the Nanobiotechnology Program is to provide a multidisciplinary education in nanoscale science and technology. The primary goals are:
- Prepare students for a career in nanotechnology by providing them with a sound grounding in multidisciplinary areas of nanoscale science and engineering.
- Increase students' understanding of materials and their properties.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Basic biology principles and practice of micro fabrication techniques, Atomic force microscopy, Biological production of metal nano particles, macro molecular assemblies, quantum dots technology and its application, Application in Biomedical and biological research, tumor targeting and other diagnostic applications.	12
II	viruses as nano-particles ,nano chemicals and application, Developing drug delivery tools through nano biotechnology, nano particle based immobilization assays. Synthesis and characterization of different classes of biomedical polymers- their uses in pharmaceutical, cardiovascular ophthalmologic, orthopedic areas. Biosensors and nano biotechnology principles used in construction of micro electronic devices ,sensors and macro mechanical structures and their functioning, immuno-nanotechnology	12

Text Book:

1. SubbaihBalaji,“Nano Biotechnology”:MJP Publishers, 2010

Reference Books:

1. Christof M. Niemeyer , Chad A. Mirkin,“Nanobiotechnology - concepts, applications and perspectives”: wiley publishers,2004.
2. Donald Martin,”Nanobiotechnology of biomimetic membranes”: springer verlag publishers, 2007.

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To learn the necessary foundation for training in research.

CO2- To provide theoretical and practical knowledge related to modern nanotechnology and get suitable job in cosmetic and sewage treatment industry

CO3- To develop the capability of reflecting on central, ethical and scientific problems relatedto nanobiotechnology.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2
CO2	PO2, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2

MSBO 0002: ENZYME TECHNOLOGY

OBJECTIVES: The course will provide an overview of the key enzymes currently used in large scale industrial processes. An overview of industrial scale protein production will be presented, including an introduction to applicable microbial expression hosts, downstream processing & purification methods, and enzyme optimization through enzyme discovery and engineering.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• History and introduction to enzymes : Classification of enzymes. IUPAC system, nomenclature, E.C. numbers. • Enzyme kinetics (Michaelis – Menten laws), importance and determination of V and K values, Hofstee's plot, L & B plots. • Bisubstrate reactions-ordered & random sequential mechanism. Theorell chance mechanism, ping pong mechanism, products of inhibition in bisubstaect reactions. • Enzyme inhibition: competitive, non-competitive and other types. • Extraction of soluble and membrane bound enzymes from microbial, plant and animal tissues. • Purification of enzymes : salt precipitation, gel fitration, ion exchange and affinity cromatography. • allosteric enzymes. • Multienzyme complexes. • Methods of storing enzymes.	10
II	• Regulation of enzyme activity, various controls (metabolic compartmentation, covalent modifications and others), feedback regulation • Mechanism of Enzyme catalysis: acid-base catalysis, substrate strain, covalent catalysis and entropy effects • Large scale production of enzymes including genetic engineering approaches for their over production. • Enzyme engineering; identification of active sites, approaches for modification of catalytic properties. • Techniques of enzyme immobilization and applications of enzymes in : Food industry – High fructose syrup, cheese making and beer industry. Antibiotics and other Pharamaceuticals Medical applications Analysis of substances, enzyme electrodes,enzyme thermistors.	14

Text Book:

- S. Shanmugam, T. Satishkumar and M. Shanmugaprakash, "Enzyme Technology" : I.K. International, 2012

Reference Books:

- T. Palmer, "Understanding Enzymes" : John Wiley & Sons, 1981
- N.C. Price and L. Stevens, "Fundamentals of Enzymology" : Oxford University Press, 1982
- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

Focus: This course focus on employability aligned with CO1& CO2

Course Outcomes: After completion of this course, the students will be able:

CO1- To explain the key structural and energetic factors which give rise to increased enzyme stability important for industrial application, summarize current processes involved in industrial enzyme production, from protein production to purification and formulation and get placed in various industry utilizing enzymes for commercial production of useful products.
CO2- To compare and contrast the historical uses of enzyme technology with current applications in a diverse range of industries.

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

COs	POs/ PSOs
CO1	PO1,PO4, PO5, PO8 /PSO2
CO2	PO1,PO3, PO5, PO6, PO8 /PSO1, PSO2

MSBO 0003: CLINICAL RESEARCH IN MEDICINAL PLANTS

OBJECTIVES: To understand the medicinal values of plants.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Alternative systems of medicine (ayurveda, siddha, unani etc.), herbal remedies-toxicity and regulations, Ethnobotany and Ethnopharmacology Need of scientific validation as per WHO & national and international agencies	10
II	Factors affecting herb quality, morphological examinations, microscopical evaluation, Development of standardization parameters Phytochemical constituents and their analysis, Pharmacological screening of herbal drugs	14

Text Book:

- Quality control of herbal drugs by Dr. Pulok K. Mukhaejee, Horizons Publisher

Reference Books:

- WHO guidelines on quality control of medicinal plants
- Quality control methods for medicinal plant materials by WHO, pub-Geneva, 1998

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To have knowledge of traditional medicine (ayurveda and its role) in treatment of diseases, assisting them to have own start up utilizing plants for production of commercial and beneficial products

CO2- To understand the acquaintance of alternative systems of medicine

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO8 /PSO1, PSO2
CO2	PO2, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2

MSMO 0002: ANIMAL CELL CULTURE

COURSE OBJECTIVES: To understand the principles of animal cell culture. As it is required for the growth of the viruses in animal cells to produce the vaccine from it.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Introduction to animal cell culture and its applications. Equipments and materials for animal cell culture technology, Introduction to balanced salt solution and growth medium, Chemical, physical and metabolic functions of different constituents of culture media. Role of serum and other supplements. Primary cell culture: Collection of tissue, enzymatic separation of cells from tissue, mechanical disaggregation of tissue, Cell viability and growth assays, cell counting,	8
II	cell lines: Routine maintenance, subculture of monolayer cells and suspension cells Cryopreservation: Principle of cryopreservation, cell concentration, freezing media, cooling rate, cryo freezers, revival of frozen cells, Scaling up of animal cell culture: Scale up in suspension and monolayer, Applications of animal cell culture: Cell culture derived vaccine, Stem cells technology and its applications.	8

Text Book:

- Animal Tissue Culture by Aruni, A.Wilson
- Biotechnology by Dubey, R.C

Reference Books:

- Culture of Animal Cells by R.I Freshney
- Animal Cell Culture: Practical Approach by John R W Masters
- Animal Cell Culture Techniques by Ed. Martin Clynes
- Methods in Cell Biology Vol. 57, Animal cell culture methods by J.P.Mather and David Barnes
- Animal cell culture & Technology- Basis from background to bench by Taylor & Fracis

Focus: This course focus on employability aligned with CO1

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

CO1- Maintain the cell lines and can use them for the growth of viruses in vaccine production

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO6, PO8 /PSO2, PSO3, PSO4

MSBO 0005: NUTRITIONAL BIOCHEMISTRY

COURSE OBJECTIVE:

The fundamental role of the subject is aware the students about the energy and nutrient need of the body. To inculcate in their minds the role of balanced diet, vitamins and essential minerals, amino acids and fatty acids. Imparting knowledge about body basic metabolism and diseases that could arise as a result of malnutrition. Thus laying the foundation towards a healthy and disease free life.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Energy need of the body: Anabolism and Catabolism, Basal metabolic rate (BMR), factor affecting BMR, its calculation and balance diet. Energy value of different food sources. • Protein & carbohydrate malnutrition, Vitamin (Water soluble and fat soluble). Vitamins and minerals deficiency, hypervitaminosis. Hormonal regulation of body metabolism (Thyroid hormone); • Hormones regulating blood glucose (Insulin, Epinephrine and Glucagon). • Different categories of Biochemicals present in food: Carbohydrates, Proteins, Fats and lipids, Essential and non essential amino acids, fatty acids.	10
II	• Basic biochemistry of Carbohydrates, Proteins, fats and lipids, to meet the energy requirement of the body (Glycoslysis, Krebcycle, ETS). • Composition of body fluids, ECF, ICF, etc. • Body homeostasis maintenance, pH maintenance, Basic buffers of the body. Conditions for Acidosis, Alkalosis and ketosis in the body. • Metabolic deficiency and diseases based on Carbohydrates, liver function test, bile pigment metabolism jaundice, renal function test.	14

Text Book:

- J.L. Jain, S. Jain and N. Jain, “Fundamental of Biochemistry”: S. Chand & Company Pvt. Ltd, 2016

Reference Books:

- J. M. Berg, L. Stryer, J. L Tymoczko and G.J. Gatto, “Biochemistry” : W.H. Freeman, 2015
- D.L. Nelson and M. Cox, “LehningerPrinciples of Biochemistry” : W.H. Freeman,
- D.J. Voet, J.G. Voet and C.W. Pratt, “ Principles of Biochemistry” : John Wiley & Sons, Inc, 2012

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To enhance the knowledge of student to uptake jobs in health sector particularly as a dietitian in hospitals, sports and assistance to food industries and dairies

CO2- To understand the importance of maintaining a healthy diet and would make them health conscious for prolongevity in their life spa

CO3- To find the placements in hospitals, sports as dietitians, etc.

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

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO2
CO2	PO1,PO2, PO6, PO7, PO8 /PSO1
CO3	PO1, PO7, PO8 /PSO2

MSBO 0006: DRUG DISCOVERY AND DEVELOPMENT

Credits: 04 **Semester III** **L–T–P: 4–0–0**

COURSE OBJECTIVES:

To demonstrate an understanding of the importance of strict quality control and regulation in the drug development process, and an awareness of issues associated with the manufacturing of medicines such as good manufacturing practice.

Module No.	Content	Teaching Hours
I	Computer Aided Drug Design, An Over-view of the different approaches used during computer-aided drug design. Structural Determination of the target enzyme, Design of the inhibitor molecules, Collection of the inhibitor molecules, Docking. Process of Drug Discovery: Reductionist target-based approach, Target identification and validation, lead identification: High through-put screening, lead optimization and prioritization: ADME-TOX properties	10
II	Process of Drug Development: considerations and strategies, cost estimates, factors for choosing candidates for drug development, preclinical studies (cell-based and animal studies), clinical studies (Phase 1, 2, 3) New strategies in drug discovery: Structure based drug designing, Molecular docking, Computer aided drug designing, chemi-informatics etc. global dynamics of proteins between structure and functions Biosensors and Devices: Introduction and its applications.	14

Text Book:

- Bioinformatics, second edition M.M. Ranga

Reference Books:

- Basic Principles of Drug Discovery and Development by Benjamin Blass

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To know drug discovery and development process, structure based drug designing and molecular docking so as to biosensors based devices.

CO2- To demonstrate an awareness of the current approaches to global drug discovery and

their advantages and limitations.

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

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO4, PO6, PO7, PO8 /PSO2

MSBO 0007: IPR, PATENT, TRADEMARKS AND BIOETHICS

Credits: 04 **Semester III** **L–T–P: 4–0–0**

COURSE OBJECTIVES:

Intellectual property rights enlighten the student knowledge towards the development of novel ideas and goods in the field of biotechnology.

Module No.	Content	Teaching Hours
I	**IPR :** Introduction to IPR, History of IPR in India. Essential elements of IPR- Trade secret, Patent, Copyright, Trademark. International harmonization of patent laws – WTO, GATT, TRIPs, WIPO. India and TRIPs, Protection of biotechnological inventions, IPR and developing countries, Broad patents in biotechnology, Choice of IPR protection, Management of IPR , Benefits and problems from IPR, Indian response to IPR upheaval. **Biosafety-** Introduction to Biosafety, Definition and objectives of biosafety guidelines. Risk Assessment- Assessment of risk during laboratory research, Risk Assessment of Biotechnolohy products. Risk regulation. Containment- Physical containment, Biological containment.	10
II	Biosafety guidelines in India, Biosafety Level – BL1, BL2, BL3 and BL4. Research involving plants – BL1-P, BL2-P, BL3-P and BL4-P. Research involving Animals- BL1-N, BL-2N, Bl3-N and BL4-N. **Bioethics-** Bioethics in Biodiversity Resource management – Definition, Ethical issues of biodiversity. Ethical issues in genetically modified organisms- Introduction, History of genetic modification, Techniques of genetic modification, Uses of genetic modification. Genetically modified food, Health implications of genetically modified food, Public health principles regarding the regulation of genetically modified food. Labeling of genetically modified food products. Benefits of labeling, Guidelines for labeling of genetically modified agricultural products. Animal cloning and their ethical aspects.	14

Text Book

- Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press.ISBN-1555811804,9781555811808.

Reference Books:

- Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219

- Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
- Intellectual property rights-Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602, B.D. Singh. Biotechnology expanding horizons
- Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rdEd) Academic ress..
- H.K.Das. Text book of biotechnology 3rd edition

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To enhance the practical applications of students to uptake challenging problems associated with patenting, intellectual property rights in the field of biotechnology which assisting them to establish small scale industry for betterment of mankind

CO2- To understand the ethical issues in genetically modified organisms

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

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO4, PO6, PO7, PO8 /PSO2

MSMC 0805: FERMENTATION TECHNOLOGY, RDT & GENOMICS & PROTEOMICS LAB

Credits: 02 **Semester III** **L–T–P: 0–0–3**

COURSE OBJECTIVES:

To inculcate in students, necessary skill-sets for conducting basic genetic engineering practicals.

Module No.	Content	Lab Hours
I	• Introduction of boifermenter (Assembly and dismenteling) • Production of alcohols in shake flask cultures at laboratory scale. • Production of citric acid in shake flask cultures at laboratory scale. • Production of alpha amylase from Bacillus species. • Isolation of plant DNA. • Purification of DNA through columns. • Restriction mapping of the DNA isolated from plant, bacteria and fungi. • Transformation of the bacterial cell. • PAGE OR Agarose gel electrophoresis of DNA • Cloning of genes in eukaryotic and prokaryotic vectors.	30

Focus: This course focuses on entrepreneurship and skill development aligned with CO1 & CO2

Outcome: The major outcomes of this course are:

CO1- Use these bioreactors for the mass production of economically important food products such as cheese, butter, yoghurt, etc. (Std. placed in Nat. Res. Lab's; Yakult Int. Ltd; AMUL, etc.)
CO2- Have better understanding of phylogenetic analysis and molecular docking so they become employable in genomics and proteomics based industrial organization

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

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO4

MSMC 0806: FOOD, DAIRY, AGRICULTURAL MICROBIOLOGY & ADVANCED IMMUNOLOGY LAB

COURSE OBJECTIVES:

The objective of this course is to well verse the students with practical knowledge of Food, Dairy and Agricultural Microbiology that they have taught in the theory and provide hands on training on practical techniques of Food, Dairy and Agricultural Microbiology related practical.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Determination of quality of milk sample using MBRT. • To detect the CFU in milk sample using SPC method. • Enzymatic browning of apples. • Isolation of casein from milk. • To study the effect of salt concentration on microbial growth. • To isolate the B. cereus and Clostridium from food • Isolation of Rhizobia from root nodule. • Isolation of antibiotic resistant bacterial population by gradient plate method. • To perform antibiotic sensitivity test against different pathogens. • Production of ethanol. • Diagnosis of typhoid, tuberculosis . • Diagnosis of HIV • Diagnosis of Hepatitis A, B and C. • Immunological diagnosis of pregnancy	30

Focus: This course focuses on employability and skill development aligned with CO1 & CO2

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

CO1- To check the quality of different dairy products and get suitable position in food and agriculture industry

CO2- To isolate and diagnose different kinds of bacteria and viruses.

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

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO4
CO2	PO1,PO2, PO4, PO5, PO6, PO7, PO8 /PSO1, PSO2, PSO3

MSME 0801: ENVIRONMENTAL MICROBIOLOGY LAB

COURSE OBJECTIVES:

The main objective of this course is to well verse the students with practical knowledge of Environmental Microbiology that they have taught in the theory and provide hands on training.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• To measure the D.O. of the given water samples. • To measure the BOD of the given water samples. • To measure the COD of the given water samples. • To enumerate the microbial flora in wheat flour by standard plate count. • To determine the bacterial count in milk by direct microscopic method. • To determine the effect of temperature on microbial growth. • To determine the effect of pH on microbial growth. • To determine the effect of oxygen on microbial growth. • To determine the hardness of the given water samples.	15

Focus: This course focuses on employability and skill development aligned with CO1& CO2

OUTCOME: The major outcomes of this course are:

CO1- After completing the practical course, students will be able to examine Physico-chemical nature of environmental samples and get suitable job prospects in ETP, STP etc.

CO2- In addition it can enhance the ability to understand related theory.

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

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO6, PO7, PO8 /PSO1, PSO2, PSO3
CO2	PO1,PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2, PSO4

MSBE 0801: NANOBIOTECHNOLOGY LAB

COURSE OBJECTIVES: The objective of this laboratory includes synthesis ,production and applications of nanoparticles.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Chemical Synthesis of silver Nano Particales (sodium borohydride) • Chemical Synthesis of silver Nano Particles (trisodium citrate) • Characterization of silver Nano Particles (By UV spectrophotometer) • Antibacterial activity of silver Nano Particles • Biological Synthesis of silver Nano Particles • Chemical Synthesis of Gold Nano Particles (Citrate Synthesis) • Characterization of Gold Nano Particles (By UV spectrophotometer • Antibacterial activity of gold Nano Particles • Biological Synthesis of gold Nano Particles	15

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To have knowledge of nano material properties and characterization and get suitable position in cosmetic and various industry utilizing nanoparticles for development of useful products

CO2- To use the tools, techniques and skills necessary to practice.

CO3- To understand of the impact of nano materials on the environment.

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

Cos	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO5, PO7, PO8 /PSO1
CO3	PO1,PO4, PO6, PO7, PO8 /PSO1, PSO2

MSBE 0802 : ENZYME TECHNOLOGY LAB

OBJECTIVES:

The objectives of this paper are to design experiments for the determination of enzyme kinetic parameters, conduct various types of enzyme activity assays on the basis of general methodological descriptions, analyze results from these assays in order to estimate enzyme activity, enzyme stability, thermal activation of enzymes, substrate saturation and inhibition constants and evaluate the validity of the enzyme kinetic results such i.e. considerations concerning the use of blank samples, substrate specificity, use of artificial or multiple component substrates and heterogenous enzyme preparations.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• To estimate standard curve of pNP so as to measure the activity of enzyme acid phosphatase • To find out the activity or amount of enzyme acid phosphatase in unit per gram of potato tissue • To find out the specific activity of enzyme acid phosphatase • To study the effect of substrate con. on the activity of enzyme acid phosphatase • To determine value of Km and Vmax of enzyme acid phosphatase by using following graph (i) Michaelis- Menton graph (ii) Lineweaver Burk plot (iii) Hofstee's plot • To study the effect of temperature on the activity of enzyme specific activity and determination of optimum temperature • To study the effect of pH on the activity of enzyme specific activity and determination of optimum Ph	15

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To understand enzyme assay system, which will help them to cope up with research and industry related to enzymes for the production of useful products

CO2- To understand the use of artificial or multiple component substrates

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO4, PO6, PO7, PO8 /PSO1, PSO2

MSBE 0803: CLINICAL RESEARCH IN MEDICINAL PLANTS LAB

OBJECTIVES: To understand the medicinal values of plants

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Authentication of Medicinal plants • Importance of seasons, climate and other environment factors on components of medicinal plants • Preparation of different parts of medicinal plants for their extract preparation • Methods used for preparation of plant extract • Phytochemical analysis of plant extract • Quantitative estimation of component(s) of plants of medicinal value	15

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To have knowledge of traditional medicine (ayurveda and its role) in treatment of diseases and extraction of commercial and useful products from different plant extracts

CO2- To have knowledge of authenticating plants.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO5, PO6, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO5, PO7, PO8 /PSO1

MSME 0802 : ANIMAL CELL CULTRE LAB

OBJECTIVES: This course aims to impart in students an understanding of the primary cell culture and methods that convert them to long term established cultures. They will be exposed to all the factors which could impact cell culture and equipment requirements for propagation.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Introduction to cell culture laboratory and instruments (Inverted microscope, CO_2 incubator, Refrigerated centrifuges, Bio-safety cabinets, cryo cans, UV lights etc) used in the lab • Washing and Sterilization of glass wares, plastic ware and different buffer/ media for animal tissue culture • Preparation of tissue culture medium trypsin • Counting of cells by haemocytometer. • Preparation of single cell suspension from spleen • Trypan blue viability check method for animal cells.	15

Focus: This course focuses on employability and skill development aligned with CO1 & CO2

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

CO1- At the end the students will demonstrate the ability for development of primary established cell culture.

CO2- Understand cell viability methods and get suitable positions in industry dealing with animal cell culture

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

COs	POs/ PSOs
CO1	PO1,PO3, PO4, PO5, PO6, PO8 /PSO1, PSO2, PSO4

MSMJ 0971: PROJECT WORK

Credits: 16 **Semester IV** **L–T–P: 0–0–0**

Module No.	Content	Teaching Hours
I	Project work	Six months

Focus: This course focuses on skill development aligned with CO1

Course Outcome: After completion of this course, students will able to

CO1. Learn fundamental and advanced biotechnological techniques used in different field for the production of useful product and for the betterment of society

M.Sc. (BIOTECHNOLOGY)
COURSE CURRICULUM

(w.e.f. Session 2018-19)

INSTITUTE OF APPLIED SCIENCES & HUMANITIES

COURSE STRUCTURE

M.Sc.

(BIOTECHNOLOGY)

First Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1	MMAS 0501	Advanced Biostatistics	GE	3	1	0	4	4
2.	MSBC0001	Biochemistry	Core	4	0	0	4	4
3.	MSBC 0002	Cell Biology	Core	4	0	0	4	4
4.	MSBC 0003	Bioinformatics	Core	4	0	0	4	4
5.	MSBC 0004	Biophysical Techniques	Core	4	0	0	4	4
PRACTICALS								
6.	MSBC 0801	Biostatistics & Biochemistry Lab	Core	0	0	3	2	3
7.	MSBC 0802	Bioinformatics Lab	Core	0	0	3	2	3
8.	MSBC 0803	Biophysical Techniques & Cell Biology Lab	Core	0	0	3	2	3
Total				**19**	**1**	**9**	**26**	**29**

Second Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSBC 0005	Immunology	Core	4	0	0	4	4
2.	MSBC 0006	Genetics & Molecular Biology	Core	4	0	0	4	4
3.	MSBC 0007	Microbiology	Core	4	0	0	4	4
4.	MSBC 0008	Environmental Biotechnology	Core	4	0	0	4	4
5.	BELH 0012	Introduction to Gender & Women's studies	GE	4	0	0	4	4
PRACTICALS								
6.	MSBC 0804	Microbiology Lab	Core	0	0	3	2	3
7.	MSBC 0805	Immunology Lab	Core	0	0	3	2	3
8.	MSBC 0806	Genetics and Molecular Biology Lab	Core	0	0	3	2	3
Total				**20**	**0**	**9**	**26**	**29**

Third Semester

S. NO.	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	MSBC 0009	Animal Biotechnology	Core	4	0	0	4	4
2.	MSBC 0010	Bioprocess Engineering & Fermentation Technology	Core	4	0	0	4	4
3.	MSBC 0011	RDT, Genomics & Proteomics	Core	4	0	0	4	4
4.	MSBC 0012	Plant Biotechnology	Core	4	0	0	4	4
ELECTIVES (Select any Two)								
5.	MSBE 0001	Nanobiotechnology	Elective	4	0	0	4	4
6.	MSBE 0002	Enzyme Technology	Elective	4	0	0	4	4
7.	MSBE 0003	Clinical Research in Medicinal Plants	Elective	4	0	0	4	4
8.	MSBE 0004	Clinical Immunology	Elective	4	0	0	4	4
ELECTIVES (Select any One)								
9.	MSBE 0005	Nutritional Biochemistry	Elective	4	0	0	4	4
10.	MSBE 0006	Drug Discovery and Development	Elective	4	0	0	4	4
11.	MSBE 0007	IPR, Patent, Trademarks & Bioethics	Elective	4	0	0	4	4
PRACTICALS								
12.	MSBC 0807	Plant Biotechnology and Bioprocess Engineering & Fermentation Technology Lab	Core	0	0	3	2	3
13.	MSBC 0808	Animal Biotechnology, RDT and Genomics & Proteomics Lab	Core	0	0	3	2	3
PRACTICALS BASED ON ELECTIVES (Select any Two)								
14.	MSBE 0801	Nanobiotechnology Lab	Generic Elective	0	0	3	2	2
15.	MSBE 0802	Enzyme Technology Lab	Generic Elective	0	0	3	2	2
16.	MSBE 0803	Clinical Research in Medicinal Plants Lab	Generic Elective	0	0	3	2	2
17.	MSBE 0804	Clinical Immunology Lab	Generic Elective	0	0	3	2	2
Total				**28**	**0**	**12**	**36**	**40**

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACT HR/WK
			L	T	P		
1.	MSBJ 0971	Project Work	-	-	-	16	-
Total			**0**	**0**	**0**	**16**	**-**

S. No.	Category	Subject	Credit	Total Credits
1	Core (Theory)	12	4	48
2	Core (Practical)	8	2	16
3	GE	2	4	8
4	Electives (Theory)	2	4	8
5	Electives (Practicals)	2	2	4
6	Elective	1	4	4
7	Project	1	16	16
8	Total Credits			104

SYLLABUS

M.Sc.

(BIOTECHNOLOGY)

MMAS 0501: ADVANCED BIOSTATISTICS

OBJECTIVES: To make the students understand the advanced concepts of biostatistics, algebra and differential equations.

Credits: 04 **Semester** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	Introduction to Vector algebra, Scalar & Vector triple products, Collinear and Coplanar vectors, Determinant and its properties, Adjoint and Inverse of a matrix (simple problems), Formation of ordinary differential equations (ODEs), Solution of ODE of I order and I degree (Variable separable and Linear forms only). Introduction to Biostatistics, Revision of measures of central tendency and dispersion,	18
II	Computation of moments, Skewness and Kurtosis by the method of moments, Introduction to probability, Additive and multiplicative laws, Conditional probability. Method of least squares for fitting of exponential curves, Sampling, Testing of hypothesis, Type I and type II errors, Level of Significance, Degree of freedom, Students' t-test, F–test, Chi-square test as a goodness of fit and as a test of independence, ANOVA (one way classification).	24

Text Books:

- P. Banerjee, Introduction to Biostatistics, S. Chand & Co., Delhi, 2006.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- H. Kishan, Differential Equations, Atlantic Publishers and Distributors, Delhi, 2008.

Reference Books:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- B. K. Mahajan, Methods in Biostatistics, Jaypee Brothers Pub., New Delhi, 2010.

Focus: This course focus on skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To recognize and give example of different type of data arising in public health and clinical studies.

CO2- To interpret difference in data.

CO3- To select an appropriate test for comparing populations.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO1, PSO2
CO2	PO1, PO2, PO4/PSO1
CO3	PO1, PO6, PO7,PO8/PSO2

MSBC 0001: BIOCHEMISTRY

OBJECTIVES: The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of lecture series.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	*Carbohydrates* **Glycolysis**: definition, location, reactions, stoichiometry, fate of pyruvate, ATP production, energetics of Glycolysis, regulation **Kreb's cycle:** definition, location, pyruvate dehydrogenase enzyme complex, reactions, stoichiometry, amphibolic nature, energetics of TCA cycle, regulatio, Mitochondrial electron transport and oxidative phosphorylation. Anaerobic respiration in bacteria. **Alternative pathways of Carbohydrate metabolism:** pentose phosphate pathway (function, location, reactions, stoichiometry, regulation), uronic acid pathway, metabolism of fructose, metabolism of lactose, metabolism of amino sugars *Amino acids* **Biosynthesis of amino acids:** biosynthesis of alanine, aspartate, asparagine, glutamate, glutamine, arginine, proline, serine, glycine, cysteine, tyrosine, feed back regulation of amino acid biosynthesis. **Amino acid degradation:** transamination, oxidative deamination, conversion of alanine, serine and cysteine into pyruvate, conversion of aspartate and asparagines into oxaloacetate, conversion of glutamine, histidine, arginine, proline into α- ketoglutarate through glutamate, conversion of methionine, isoleucine, valine into succinyl-CoA, catabolism of phenylalanine, tyrosine and tryptophan	18
II	*Lipids* **Biosynthesis of fatty acids:** formation of malonyl CoA, fatty acid synthase complex, reactions of fatty acid synthase, elongation of fatty acid chains, regulation of fatty acid biosynthesis. **Fatty acid oxidation:** activation of fatty acids, role of carnitine in transport of long chain fatty acid, β oxidation of saturated and unsaturated fatty acids, oxidation of odd chain fatty acids, regulation of fatty acid oxidation *Nucleic acids* **Biosynthesis of Purine and Pyrimidine Nucleotide:** De novo synthesis of purine nucleotides, regulation of De novo synthesis of purine nucleotides, salvage pathway for purine nucleotides, De novo synthesis of pyrimidine nucleotides, regulation of pyrimidine synthesis, salvage pathway for pyrimidine nucleotides, formation of deoxy ribonucleotides Degradation of Purine and Pyrimidine nucleotides. **Inborn errors of metabolism:**Protein- PKU, Alkaptonuria, Maple syrup & Gauchers disease Carbohydrates: glycogen storage disorders, Cori's disease & Pomes disease Lipids- Atherosclerosis. Nucleic acids- Gout, Lesch-Nyhan syndrome, Sickle cell anaemia	24

Text Book:

- J.L. Jain, S. Jain and N. Jain, "Fundamental of Biochemistry": S. Chand & Company Pvt. Ltd, 2016

Reference Books:

- J. M. Berg, L. Stryer, J. L Tymoczko and G.J. Gatto, "Biochemistry" : W.H. Freeman, 2015
- D.L. Nelson and M. Cox, "Lehninger Principles of Biochemistry" : W.H. Freeman,
- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

Focus: This course focus on employability aligned with all COs

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

CO1- Describe the Metabolism of carbohydrates, lipids and its regulation.
CO2- Describe the metabolism of amino acids, nucleic acids and its regulation.
CO3- Understand the concept of inborn errors of metabolism.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO7/PSO1, PSO2
CO2	PO2, PO4, PO5, PO8/PSO1, PSO2
CO3	PO1, PO3, PO5, PO6, PO8/PSO1, PSO2

MSBC 0002: CELL BIOLOGY

OBJECTIVES: The course has been designed to be approachable, under stable and teachable text. Almost all aspect of cell has been incorporated to make the syllabus relatively self contained.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Cell as a unit of living system, Discovery of cell, development of cell theory, structure of Bacterial, plant and animal cell • Cell membrane- structure and function • Transport across cell membrane: Passive transport, active transport by ATP driven pump- types, properties and mechanism, bulk transport: endocytosis, exocytosis, pincocytosis, phagocytosis • Intracellular communication through cell junction: occluding junction, anchoring junctions and communicating junction. Structure and function of endoplasmic reticulum, golgicomplex, ribosomes, lysosomes, peroxisomes, plastids and mitochondria. Biogenesis of mitochondria and chloroplast.	18
II	• Nuclear ingredients: Nuclear membrane, nature of genetic material, protein associated with nuclei, packaging of genetic material-nucleosome model, Histones, organization of chromatin, chromosome structure. • Synthesis of secretary & membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes • Cell signaling: exocrine, endocrine, paracrine and synaptic strategies of chemical signaling, surface receptor mediated transduction (DAG, Ca++. c-AMP , G-protein) • Steps in cell cycle, cell cycle check points, cell division control and regulation • Apoptosis: phases and significance, morphological and biochemical changes associated with apoptotic cell • Oncogenesis	24

Text Book:

- Cell Biology by Rastogi, Veer Bala
-

Reference Books:

- Molecular Biology of the cell by Alberts, et al
- Molecular Cell biology by Lodish, et al
- Working with Molecular Cell Biology: A study companion by Stories et al
- Cell and Molecular Biology: concepts and Experiments by Gerald Karp
- The cell: A Molecular Approach by G.M.Cooper

- The world of Cell by Becker et al
- Cell proliferation and apoptosis by Hughes and Mehnet
- Essential Cell Biology by Alberts et al
- Cell biology, genetics, molecular biology, evolution and ecology by Verma and Agrawal
- Cell and molecular biology, de Robertis & df Roberties

Course Outcomes: After completion of this course, the students will be able:

CO1- To help students to understand the subject matter particularly exciting and new area of cell regulation including cell signaling, the cell cycle, appoptosis and cancer.

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

COs	POs/ PSOs
CO1	PO1, PO3,PO4, PO5, PO7/PSO1, PSO2

MSBC 0003: BIOINFORMATICS

OBJECTIVES: To expose students with essential elements of bioinformatics, viz. structural bioinformatics, functional bioinformatics, database searching and scope of various biological databases in life science research.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction to Biological Databases** Nucleotide databases at NCBI (GenBank, ESTs, SNP, UniGene, STS, RefSeq), File Formats, Access to Information via Entrez Gene at NCBI, Other databases: PubMed, OMIM, Taxonomy Chemical classification of amino acids, Principles of protein structure (Primary, Secondary, Tertiary and Quaternary), dihedral angle (ψ and φ), Ramachandran Plot, Protein database: UniProt), and Taxonomic System for Protein Structure: SCOP, CATH, Structural Databases (PDB, MMDB) **Techniques in Bioinformatics** Sequence Alignment: Global Alignment vs. Local Alignment, Dynamic Programming, and Concept of amino acids scoring matrices in Alignment: Dayhoff PAM matrices, BLOSUM Matrices,	14 18
II	Database similarity searching: BLAST, psi BALST Multiple Sequence Alignment: Star Alignment Heuristics, Applications of MSA: PSSM, Profiles, HMM. **Structural and Functional Bioinformatics** Identification of Protein Motif and Domain using MSA, Motif databases: PROSITE, PRINT, BLOCKS, InterPro, and Protein Tertiary Structure Prediction: homology modeling, Threading & Fold recognition, ab intio, Introduction to Microarray technology (Affymatrix, Agilent, cDNA), Text Mining for information extraction from Biomedical Literature	24

Text Book:

- Bioinformatics: Principles & Application by Zhumur, Ghosh

Reference Books:

- Computational Methods in Biotechnology – Salzberg S. L. et al., Elsevier Science.
- Statistical Methods in Bioinformatics-Evens & Grants, Springer-Verlag, NY.
- Computational Molecular Biology- Setubal and Meidanis, PWS publishing Co.
- Protein Structure Prediction-A Practical Approach, MJE Sternberg, Oxford University Press.
- Purifing Protein for Protemics, Richard J. Sinpson, I.K. International Pvt. Ltd.

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To acquaint fundamental knowledge of bioinformatics tools.

CO2- To learn techniques effectively how to utilize these resources in life science research.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4, PO7/PSO1, PSO2
CO2	PO2, PO4, PO5, PO8/PSO1, PSO2

MSBC 0004: BIOPHYSICAL TECHNIQUES

OBJECTIVES: To provide scientific understanding of analytical techniques and detail interpretation of results.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• **Microscopic techniques**: Principle of light microscopy, Phase contrast microscopy, Fluorescence microscopy, Scanning and Transmission Electron Microscopy, Staining procedures in light and Electron microscope, Confocal microscopy, Atomic force microscopy • Centrifugation: Principle, RCF, Rate Zonal and isopycnic density gradient centrifugation, Preparative and analytical ultracentrifuges, molecular weight determination, sedimentation analysis • **Chromatography techniques:** TLC, Gel filtration chromatography, Ion –Exchange chromatography, Affinity chromatography, Tandom affinity purification, Gas-liquid chromatography, HPLC	18
II	• **Electrophoresis techniques:** Principle and application of PAGE, SDS-PAGE, Iso-electric focusing, 2D electrophoresis, Agarose gel electrophoresis, Pulse Field Gel Electrophoresis, Orthogonal field alteration gel electrophoresis, Southern, Northern and Western blotting. • **Spectroscopic techniques:** Principle and application of UV, Visible and IR spectroscopy, Fourier transform IR spectroscopy, Fluorescence spectroscopy, ESR, NMR, Atomic absorption spectroscopy, Mass spectroscopy, Raman spectroscopy, ORD and CD spectroscopy, X-ray crystallography, Flow cytometry	24

Text Book:

- Biological Instrumentation & Methodology by Bajpai, P.K

Reference Books:

- Principle and Techniques in Biochemistryand Mol. Biology, by Keth, Wilson and Walker.
- Protein Purification Principle and Practices by Scopes, Robert K.
- Tools in Biochemistry David Cooper.
- Methods of Protein and Nucleic acid Research, Osterman Vol I – III.
- Principle of Instrumentation analysis by Skoog & West.
- Biophysical Chemistry by Upadhyay & Nath.
- Physical Biochemistry: Application to Biochemistry and Molecular Biology by Freilder.

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To assimilate the principles and applications of centrifuge, electrophoresis and

chromatography in research and related experiments.

CO2- Students could amalgamate classical analytical chemical techniques with modern technologies of manufacturing and analysis

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

COs	**POs/ PSOs**
CO1	PO1,PO2, PO3, PO4, PO7/PSO1, PSO2
CO2	PO1,PO5, PO6, PO7, PO8/PSO1, PSO2

MSBC 0801: BIOSTATISTICS & BIOCHEMISTRY LAB

OBJECTIVES:

The course aims at providing students with the methodological concepts and tools needed to acquire top-level skills in the field of biochemistry. Ensuring that students acquire an extensive and sound knowledge base for future research

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• To carry out preparation of Buffer: Acetate Buffer • To carry out qualitative analysis of Carbohydrates • To carry out qualitative analysis of Lipids • To carry out qualitative analysis of amino acids • To carry out qualitative analysis of Proteins • Determination of Blood Group • To carry out estimation of carbohydrate by Anthrone method • To carry out estimation of DNA by Diphenylamine method • To carry out estimation of RNA by Orcinol method • To carry out estimation of protein by Biuret method • To carry out estimation of protein by Folin- Lowry's method • To carry out estimation of cholesterol in blood serum • To carry out separation of amino acid by Paper Chromatography & determination of Rf value	30

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To understand basic fundamental concept of metabolism
CO2- Describe the qualitative analysis of carbohydrates, lipids, protein and nucleic acid
CO3- To understand the quantitative analysis of carbohydrates, lipids, protein, nucleic acid and cholesterol

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

COs	POs/ PSOs
CO1	PO2,PO4, PO5, PO7 /PSO2
CO2	PO1,PO4, PO6, PO7,PO8 /PSO1, PSO2
CO3	PO1,PO4, PO5, PO8 /PSO1

MSBC 0802: BIOINFORMATICS LAB

OBJECTIVES:

Practical are designed to inculcate skill-sets in students to navigate biological databases and utilize bioinformatics software and ascertain them computational possibilities in biotechnology/microbiology.

Module No.	Content	Lab Hours
I	• Database searching against a query sequence and selection of orthologous sequences • using BLAST • Multiple Sequence Alignment using Clustal W • Prediction of Open Reading Frames using ORF Finder • 3 Dimensional Structure of protein using Deep View • Phylogenetic Analysis using Phylip (Neighbor Joining and Maximum Likelihood) • Bio programming using Practical Extraction and Reporting Language (PERL)	15

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To use tools and techniques of bioinformatics effectively.

CO2- To apply bioinformatics applications efficiently.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO4, PO5, PO7, PO8 /PSO2
CO2	PO1,PO4, PO6, PO7,PO8 /PSO1, PSO2

MSBC 0803: BIOPHYSICAL TECHNIQUES AND CELL BIOLOGY LAB

OBJECTIVES:

Biophysical techniques form the basis for all aspects of modern Biotechnology. The objective of the course is to advance the student's knowledge of spectroscopic, electrophoresis, chromatographic techniques and other current biophysical methods.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Introduction to the laboratory, good lab practices. • Introduction to instruments and glassware that are routinely used in the laboratory • Paper chromatography of carbohydrates • 2D paper chromatography • TLC of fatty acids/lipids • Gel Filtration: Determination Vo separation of Blue Dextran and Cobalt chloride or Protein and amino acid by Sepahdex-G10 • Separation of proteins by PAGE, SDS- PAGE • Agarose gel electrophoresis of nucleic acids • Immunoelectrophoresis, Agar gel diffusion, counter 97mmune electrophoresis • Estimation of proteins by Lowry's method and UV spectrophotometer • Microscopy: working of simple, compound, phase contrast microscopes, inverted microscopes • Micrometry: Calibration of stage and ocular micrometer and measurement of the given biological sample • Cell counting with Haemocytometer • RBC: Osmotic fragility determination: The effect of hypertonic, hypotonic and isotonic environment of human RBC. • WBC: Differential counting • Cell motility and flagellar staining • Sub Cellular fractionation by differential centrifugation and density gradient (sucrose/ percoll/ CsCI). • Chromosome preparation: Mitosis-Onion root tip/ human lymphocytes • Chromosome preparation: Meiosis- Rat/mouse testis/ Grasshopper testis/ anthers.	30

Focus: This course focus on employability and skill development aligned with all COs

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

CO1- Understand fundamental concept of instrumentation

CO2- Describe the qualitative analysis of carbohydrates, lipids, protein and nucleic acid

CO3- Understand the quantitative analysis of carbohydrates, lipids, protein, nucleic acid and cholesterol

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

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO2
CO2	PO1,PO2, PO3, PO6, PO8/PSO1, PSO2
CO3	PO1, PO3, PO6, PO7/PSO1,

MSBC 0005: IMMUNOLOGY

OBJECTIVES: To learn about the structural and functional features of the components of the immune system and emphasis will be on the mechanisms involved in immune system, development and responsiveness.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Overview and importance of Immunology. • Cells and organs involved in immune system. • B cell development. • T cell development • Molecules communicating among cells of immune system their receptors & signaling. • **Innate immunity (Nonspecific defense mechanism) –** Definition, Ubiquity, Innate defensive barriers, (Anatomical, Physiochemical and cellular) phgocytosis and inflammation, Generation of anti microbial mechanisms, Receptors (TLR, Scavenge receptor etc.) of the innate immunity, Signal transduction pathways in activation of innate immunity, Link between Innate and adaptive immunity. • **Adaptive immunity (Specific defense mechanism)-** Definition, Types of adaptive immunity, Attributes, Antigen (Immunogen) Haptens Definition, properties and types, Factors affecting antigencity, Epitopes recognized by B and T lymphocytes, Adjuvants, examples and mechanisms in enhancing antigenecity. • **Immunoglobulins-** Definition, Basic structure, classes and subclasses, Physico-chemical and biological properties, Antigenic determinants on immunoglobulins, Functions of Fab and FC portion of ig : Enhancement of phagocytasis (opsonization), Activation of complement, Killing of target cell by ADCC, Transcytosis, Chemical vignette, Monoclonal and genetically engineered antibodies. Organisation of immunoglobulin genes, Mechanisms for generating regulation of Antibody Diversity. • Class switching. • Immunoglobulin gene super family.	18

II	• Antigen - Antibody interactions, General properties of Ag-Ab interaction, Importance in host and in laboratory, Principles and applications of in invitro Ag.Ab interactions, Different types of serological tests (Precipitation, Agglutination, CFT, Immunofluorescence, RIA, ELISA, Flowcytometry). • **The major histocompatibility complex (MHC)-** Structure and functions of MHC molecules, Organisation of MHC genes & MHC molecules, expression patterns, The endogenous pathway of antigen processing and presentation, The Exogenous pathway of antigen processing and presentation, Self –MHC restriction, Presentation of non peptide antigen. • **Immunomediated disorders-** • **Hypersensitivity and Allergy –** Definition, Classification, Distinguishing Features of Immediate and Delayed Hypersensitivity, IgE Mediated Hypersensitivity (Type I), Method used for Detection, Anaphylactic Reaction. Antibody Mediated Cytotoxicity (Type II) Hyper Sensitivity, Mechanism and Examples, Immune Complex (Type III) Hypersensitivity: Localized and Generalized Type III Reactions, Mechanism, Anybody Mediated Cell Stimulation (Type V) Hypersensitivity. Mechanism, Delayed (Type IV) Hypersensitivity Mechanism and Important Aspect in Diagnosis of Diseases • **Immuno Tolerance, Auto Immunity and immuno deficiency.** • **Vaccines and Toxoids** o Inactivated and Live Attenuated Vaccines o Sub unit Vaccines (synthetic & recombinant) o Conjugate Vaccines, multi component vaccine o Recombinant Vector Vaccines o DNA Vaccines o Toxoids.	24

Text Book:

Immunology by Shetty, N

Reference Books:

- Immunology by Kuby (Free man publication)
- Essentials of immunology by Roitt (Blackwell scientific publication)
- Immunology by Benacera
- Infection & Immunity by John Playfair & Gregory Bancroft (Oxford university Press)
- Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
- Immunology by C. Fatima

Focus: This course focus on employability aligned with all COs

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

CO1- Understand the ability of our defense mechanism to protect against invading pathogens in logical fashion.

CO2- Understand the mechanism of molecules communicating among cells of immune system their receptors & signaling

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

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO6, PO7/PSO1,

MSBC 0006: GENETICS & MOLECULAR BIOLOGY

OBJECTIVES: Biomolecules are important constituents of organism, Molecular biology provides the knowledge of DNA , RNA and Proteins for the organization of life and their function in different vital concept of life.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Basics of genetics • Organization of Prokaryotic and Eukaryotic Genome. • DNA Replication machinery in Prokaryotes and Eukaryotes . Regulation of DNA replication. • DNA repair mechanism. • Transcription in prokaryotes and Eukaryotes, Reverse transcription. • RNA processing, and editing. Regulation of gene expression in prokaryotes: • Regulation of gene expression in eukaryotes: Activators, and Insulators, Chromatin Remodeling, Chemical Modifications of Histones: role of Histone Acetyl transferases, and Deacetylases, Signal Transduction and control of transcriptional regulation, microRNAs and their role in gene expression regulation • Genetic Code: Evidence and properties; Wobble hypothesis; Transcriptional adaptors and amino acyl tRNA synthases	18
II	• Translation: Successive stages of protein synthesis in prokaryotes and eukaryotes • Protein degradation via proteasomes • Post-translational Modification: Types and Significance • Genetic recombination in prokaryotes and eukaryotes and its molecular mechanism. • Transposable elements in Prokaryotes and Eukaryotes: Types and Significance • Chromosomal and gene mutation • Introduction and application of Molecular markers (RFLP,AFLP.RAPD,SNP, and VNTR) • Biomedical Genetics & its application • Modern molecular Diagnostic techniques.	24

Text Book:

- Cell Biology, Genetics, Molecular Biology by Verma, P.S
- Molecular Biology by Friefelder, David

Reference Books:

- Albert B, Bray Denis et al.: Molecular Biology of The Cell.
- Watson, Hopkin, Roberts et al.: Molecular Biology of the Gene.
- Genetics- Strickberger.
- Microbial Genetics – D. Frifielder.
- Baltimore- Molecular Biology of the Cell.
- Benjamin Levin – Genes VIII.
- Advance Genetics by G.S. Miglani, Narosa Publishing House.

- **Focus:** This course focus on employability and skill development aligned with all COs

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To provide the different concept of expression of genetic molecule DNA, RNA and proteins and their association with the genetic and physiological variation of higher and lower organism and how they are associated with each other and how their character inherited from generation to generation.

CO2- To learn how the Molecular biology is important in forensic science.

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

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2

MSBC 0007: MICROBIOLOGY

OBJECTIVES: Since microbes are ubiquitous and play role in most of spheres in the universe. Discuss about the historical concept of spontaneous generation and how Koch's postulates are used to establish the causal link between a suspected microorganism and a disease and describe some of the various activities of microorganisms that are beneficial to humans.

Credit: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• **Introduction, History and Overview of Microbiology**- Members of the microbial world, Discovery of microorganism, Biological classification of microorganisms, The Golden age of Microbiology, Scope and relevance of Microbiology, Future of Microbiology. • **Morphology and Anatomy of Prokaryotic cell, Structure and Function-** An overview of morphology of bacteria, bacterial cell wall, Archaeal cell walls, Cell membrane, Cytoplasmic matrix, The nucleoid, Extra chromosomal nuclear material, Intra cytoplasmic structures, Protein secretion in prokaryotes, Structures external to the cell wall, Comparison of Prokaryotic and Eukaryotic cell. • **Classification of Bacteria -** Definition, criteria of classification of Bacteria, Classification system, Description of the major categories and groups of bacteria. • **Microbial Nutrition, Growth and Metabolism** - Common nutrient requirements, Nutrient based classification of Microorganisms, Growth factors, Growth curve, Uptake of nutrients by the bacterial cell. culture media and their importance in isolation of pure cultures, Bacterial enzymes, The continuous culture of microorganisms, Role of Metabolism in biosynthesis and Growth. • **Sterilization and Disinfection -** Definitions, The pattern of microbial death, Type of physical methods and uses, Disinfectants and mechanism in control of microorganisms. Evaluation of antimicrobial agent effectiveness. **Microbial Genetics**- Genetic material, The flow of genetic information, Mechanisms of genetic variation, Mutations and their basis, Detection and Isolation of Mutants, DNA Transformation, Transduction, Bacterial Conjugation, Transposable element, Bacterial plasmids, Mapping the Genome, Recombination and Genome mapping in viruses	18

II	• **Viruses –** History and Overview, General properties of viruses, Chemical composition of virus, Structure of viruses, Virus replication, Virus cultivation, Virus purification. • **Classification of virus-** Principles of virus taxonomy, Criteria of virus classification. DNA phages, RNA phages, Plant viruses, Viruses of fungi and protists, Virus and cancer, Persistent, latent and slow virus infection, Viriods, Virusoids and Prions. • **Pathogenesis of Microbes-** Pathogenesis of microorganisms, Host- parasite relationships, pathogenesis of bacterial infection Pathogenesis of viral diseases, Toxigenecity, Host defense against microbial invasion, Microbial mechanisms for escaping host defenses. • **Antimicrobial Therapy-** Development of chemotherapy, The use of antibiotics in microbial research, General Characteristics of antimicrobial drugs, Determination of antimicrobial activity, Bacteriostatic and Bacteriocidal drugs, Factor affecting antimicrobial drug effectiveness, Drugs resistance, Antifungal and antiviral drugs. • Important bacterial diseases, Important fungal diseases, Important Viral diseases and zoonotic diseases.	24

Text Book:

- Microbiology by Pelezar, Michael J

Reference Books:

- Microbiology, Authors- Pelczar, Chan and Kreig.
- Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case, C.L.
- General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter.
- Microbial Physiology, Authors- Moat and Foster.
- A Text book of Microbiology, Authors- P. Chakraborty.
- Textbook of Microbiology, Authors- Dubey and Maheshwari.
- Microbiology, A Practical Approach. Authors- Patel and Phanse
- General Microbiology, Authors- Powar and Daginawala.
- Microbiology, Author- S.S. Purohit.
- Microbiology, Authors- Presscott, Herley and Klein.
- Bacteriology, Authors- Topley and Wilson.

Focus: This course focus on employability aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To identify the major categories of microorganisms and analyze their classification, diversity and ubiquity.

CO2- To understand history, biology of microorganisms, growth and control of microbes. Thus the beginners are rightly exposed to foundation of Microbiology which would lead them towards progressive advancement of the subject.

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

COs	**POs/ PSOs**
CO1	PO1, PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO4, PO5, PO6, PO7, PO8 /PSO1, PSO2

MSBC 0008: ENVIRONMENTAL BIOTECHNOLOGY

OBJECTIVES: One of the main objectives of Environmental Biotechnology is the conservation of resources via the recycling of waste materials. The recoveries of more valuable products such as metals, oils, and vitamins are important aspects of this technology.

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• **Introduction and Scope of Environmental Biotechnology**. • **Water Pollution and Its Control**- Sources of wastes and pollutants, Hazards from wastes and pollutants. Solid waste disposal- Sanitary landfills and Composting. • Liquid waste treatment- Small scale sewage treatment- Cesspool, Septic tanks; Large scale sewage treatment- Primary, Secondary and Tertiary Treatment, Oxidation ponds, Trickling filter, Biodisc system, Activated sludge and Anaerobic digesters. • **Microbial Insecticides**- Bacterial, fungal and viral insecticides. **Biogeotechnology**- Bioleaching of copper, Desulphrisation of coal, Merits of using microbes for ore leaching	18
II	• **Biofertilizers-** Nitrogen fixing and phosphate solubilizing biofertilizers. • **Biodegradation**- Biodegradation of industrial waste- Pesticide waste, Toxic heavy metals, Petrol and Petroleum products (Oil spill causing pollution) Biodegradation of xenobiotic compound- Hazards from xenobiotics, Hydrocarbon degradation and Biodegration of halogenated compound. • **Bioremediation**- Introduction need and scope of Bioremediation, Environmental applications of Bioremadiation, Phytoremediation (Biotechnology of cleaning up the environment by plants) and its future.	24

Text Book:

- Biotechnology by Dubey, R.C

Reference Books:

- Waste water treatment for pollution control by Arceivala.
- Environmental Microbiology. R. M. Maier, I. L. Pepper & G. P. Gerba
- Comprehensive Biotechnology Vol. – 4. Murray Moo Young.
- Biotechnology. Rehm and Reid.
- Biotechnology . B.D.Singh.
- Microbiology. P.D. Sharma.

- Environmental chemistry. A.K.De, Wiley Eastern Ltd., New Delhi.
- Introduction to Biodeterioration. D.Allsopp and Seal, ELBS/ Edward Arnold.
- Environmental Biotechnologies and Cleaner Bioprocess by Eugenia J Olguuin et al.
- Environmental Science: Physical Principles and applications by Egbert Booker et al.

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To understand the recovery of minerals of commercial interest is also an interesting area.

CO2- To learn the reclaiming process of organically polluted water, application of microbes to degrade recalcitrant compounds. Use of animal waste as fertilizer, recycling of microbial protein as an animal feed

CO2- Removal of heavy metals found in sewage sledges, are examples of this type of technology.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO8 /PSO1, PSO2
CO2	PO1, PO2, PO4, PO5, PO6, PO7, PO8 /PSO1
CO3	PO2, PO4, PO5, PO7 /PSO1, PSO2

BELH 0012: INTRODUCTION TO GENDER & WOMEN'S STUDIES

OBJECTIVES: An introductory course designed to introduce students to a variety of issues and disciplinary approaches to the study of women and gender. Classes will use audio-visual methods with oral presentations by students. Emphasis is given to the English language skills for oral communication and writing. Compulsory attendance. Limited enrolment for supervised learning.

EXPANDED DESCRIPTION: The question of gender is often a vexing one that has been important in shaping human experience and culture. We will explore how gender intersects with class, ethnicity, religion, age and other categories of experience. This course will focus primarily on gender and women's issues in the modern world. In addition to assigned readings from a range of texts, we will also attempt to examine representations of women and their condition in film and other media.

Themes: With a focus on issues of gender in domestic and workplace situations, the course will use the reading selections and multimedia materials to address a wide range of topical categories and themes, which will also be the base of students' Oral/Group Presentations:

Credits: 2 **Semester: II** **L-T-P: 2-0-0**

Module	Content	Teaching Hours
I	**Introduction** Becoming a Man or Woman: Emotions, Love, Beauty and the Media Women, Men & Sexuality: Gender & Human Bodies Modernity and Power: Institutions that Shape Our Lives Violence against Women: Domestic & Work Spaces Women and Violence: War and Terrorism	**12**
II	Health & Reproductive Freedom: Mothering and Parenting Differences among Us: Ageism, Racism and Prejudice **Review** Changing Our World: Culture, Society & Practice of Gender Sensitization Oral Presentations by Students	**18**

Recommended Reading:All materials will be available via email or online LMS (there are no course textbooks to purchase). Students will require access tothe internet and a computer.

Audio-Visual Material:Audio recordings will be made available via CDs and online.

References: Study-pack derived from *Women: images and realities. A multicultural anthology*. 4th edition. Edited by Amy Kesselman, Lily D. McNair, Nancy Schniedewind. McGraw-Hill, 2007.

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

CO1- Identify important terms and concepts in the field of gender studies
CO2- Discuss the significance of important work done in this field
CO3- Discuss how different factors like age, ethnicity, race and culture impact human experiences
CO4- Discuss how women's studies and gender sensitization have led to revisions of cultural assumptions and practices regarding women
CO5- Relate gender concepts to our lived experiences
CO6- Be able to develop an oral presentation on a proposed project in some area of gender sensitization

Value Addition: Students will be able to connect, write and speak with confidence and clarity about their own responses to the selected readings and about gender and women's issues from multiple perspectives.

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

COs	**POs/ PSOs**
CO1	PO1, PO4, PO7, PO8 /PSO1, PSO2
CO2	PO2, po3, PO4, PO5, PO7, PO8 /PSO1
CO3	PO2, PO8 /PSO1, PSO2
CO4	PO1, PO2, PO8 /PSO2
CO5	PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO6	PO2, PO5, PO7, /PSO1, PSO2

MSBC 0804: MICROBIOLOGY LAB

OBJECTIVES:

The main objective of this course is to well verse the students with practical knowledge of Microbiology that they have taught in the theory and provide hands on training on practical techniques.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Basic laboratory techniques for isolation, cultivation and cultural characteristics of bacteria, isolation of pure culture from mixed population • Bacterial staining. • Biochemical and enzymatic activities of bacteria. • Cultivation of moulds and other fungi. • Identification of unknown bacteria acid fungi. • Cultivation of virus in embryonated egg and cell culture, demonstration of cypopathic change. • Demonstration of virus by HA Test, and HI test • Physical and chemical methods for sterilization. • Microbiological analysis of Food Products (viable count). • Microbial analysis of water – Presumptive test, Determination of most potable number of coliform bacteria, confirmed test and completed test. • Quantitative microbial analysis of water by membrane filter method. • Isolation of streptomycin resistant mutants, Antibiogram test. • Demonstration of conjugation process in bacterial. • Anti biotic sensitivity test.	30

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To observe the morphology of bacteria by using different staining techniques.
CO2- To culture the bacteria and fungi in –vitro.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO2, PO8 /PSO2

MSBC 0805: IMMUNOLOGY LAB

OBJECTIVES:

The main objective of this course is to well verse the students with practical knowledge of Immunology that they have taught in the theory and provide hands on training on practical techniques. In addition to this emphasis will be on the mechanisms involved in immune system.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Handling of laboratory animals. • Routes of inoculation in lab animals. • Preparation of antigen • Raising of antisera for agglutination test. • Raising of antisera for precipitation test. • Gel diffusion test- o Redial diffusion test. o Ouchterlany diffurion test. o Rocket electrophoresis. o Immuno electrophoresis. • Slide agglutination test. • Tube agglutination test / Passive agglutination. • ELISA Test- o Indirect ELISA. o Sandwich ELISA. o Competetive ELISA. o ELISA Test. • Haemagglutination test. • Haemagglutination inhibition test. • Demonstration of anaphylactic shock. • Demonstration of T cell by rosette formation. • Demonstration of macrophages by glass adherence. • Purification of antibodies by Saturated $(NH4)_2 SO_4$ • IFT & IPT	30

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To handle the laboratory animals.

CO2- To learn different antigen antibody reactions with isolation and identification of different kinds of bacteria with conceptual understanding of the subject.

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

COs	**POs/ PSOs**
CO1	PO2, PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO2, PO4, PO6, PO7, PO8 /PSO1

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MSBC 0806: GENETICS AND MOLECULAR BIOLOGY LAB

OBJECTIVES:

To well verse the students with practical knowledge of molecular biology that they have taught in the theory and provide hands on training on practical techniques of molecular biology related practical.

Credits: 02 **Semester II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Estimation of DNA content in the given sample by diphenylamine method • Estimation of RNA content by the Orcinol method. • Determination of Tm of DNA and RNA. • Isolation of Plasmid DNA. • Isolation of bacterial/fungal genomic DNA. • Isolation of plant DNA. • Purification of DNA through columns. • Restriction mapping of the DNA isolated from plant, bacteria and fungi. • Transformation of the bacterial cell. • PAGE OR Agarose gel electrophoresis of DNA • Cloning of genes in eukaryotic and prokaryotic vectors.	30

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To perform different molecular techniques for isolation of DNA, RNA etc.
CO2- To perform various methods for demonstration and handling of virus.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO4 PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO4, PO6, PO7, PO8 /PSO1, PSO2

MSBC 0009: ANIMAL BIOTECHNOLOGY

OBJECTIVES: To understand the principles of animal cell culture, its latest developments and applications. The aim is to understand to make products, to improve animals and to develop microorganisms for specific agricultural uses.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Introduction to animal cell culture, Equipments and materials for animal cell culture technology, sterilization of glassware, plastic ware, medium, buffers etc maintenance Introduction to balanced salt solution and growth medium, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture media. Role of serum and other supplements, Serum and protein free defined media and their applications. Biology of cultured cells. Primary cell culture: Collection of tissue, enzymatic separation of cells from tissue, mechanical disaggregation of tissue Cell viability and growth assays, cell counting cell lines: Routine maintenance, subculture of monolayer cells and suspension cells	18
II	Characterization and authentication of cell lines Transformation and immortalization of cells Cryopreservation: Principle of cryopreservation, cell concentration, freezing media, cooling rate, cryo freezers, revival of frozen cells. Scaling up of animal cell culture: Scale up in suspension and monolayer Organ Culture: 3D cell culture and tissue engineering Expression of recombinant proteins: IFN-gamma, IL-2, GMCSF,& PDGF Applications of animal cell culture: Cell culture derived vaccine, Stem cells technology and its applications. Epithelial stem cell identification, isolation and culture	24

Text Book:

- Animal Tissue Culture by Aruni, A.Wilson
- Biotechnology by Dubey, R.C

Reference Books:

- Culture of Animal Cells by R.I Freshney
- Animal Cell Culture: Practical Approach by John R W Masters
- Animal Cell Culture Techniques by Ed. Martin Clynes

- Methods in Cell Biology Vol. 57, Animal cell culture methods by J.P.Mather and David Barnes
- Animal cell culture & Technology- Basis from background to bench by Taylor & Fracis

Focus: This course focus on employability aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To describe the steps involved in the production of biopharmaceuticals in microbial and mammalian cell systems.

CO2- To characterize and authenticate the cell lines.

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4 PO5, PO6, PO8 /PSO1, PSO2
CO2	PO1, PO2, PO4, PO6, PO7, PO8 /PSO1, PSO2

MSBC 0010: BIOPROCESS ENGINEERING & FERMENTATION TECHNOLOGY

OBJECTIVES: Bioprocess engineering is associated with the utilization of different biochemical, physical, Biological and microbial concept in production of different fermented and Bioprocessed product. Bioprocessing provide the knowledge of different types fermentation and concept of regulation of metabolite production in microbes.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Introduction to Bioprocesses Engineering. Kinetic of microbial growth and death, Bioreactors: Principle, Kinetics, types, design, analysis and application.Types of fermentation processes: analysis of batch, Fed-batch and continuous Bioreactions, stability of microbial reactions. Aeration and Agitation systems for bioreactor.Flow behavior of fermentation fluids Gas-Liquid mass transfer, Solid and Liquid-phase mass transfer and Heat transfer. Measurement and control of bioprocess parameters. Media for industrial fermentation. Air and media sterilization, safety in fermentation laboratory.Strain improvement of industrially important microorganism, Classification of product formation, Product synthesis kinetics, Mass balance in bioprocesses system, Energy balance in Bioprocess system. Biochemistry of Fermentation	18
II	Downstream processing: Introduction, removal of microbial cells and solid matter. Foam reparation, precipitation, centrifugation, cell disruption, chromatography. Product recovery processes and Unit operations. Safety consideration in down stream processing Immobilization of cell and Enzyme and their application , Production, feed back controle and factors affecting the commercial production of following products – Ethanol, citric acid and Acetic acid, glycerol, Antibiotics (penicillin, streptomycin. tetracycline), Aminoacids (lysine, glutamic acid), Single Cell Protein. Introduction to food Biotechnology, fermented milk products, microorganism involved in spoilage of food and prevention of spoilage of food. Canning and Packeging of Biobrocessed food. Economics of fermented products.	24

Text Books:

- Principles of Fermentation Technology by Whilteker, A

Reference Books:

- Biochemical Engineering, Aiba *et al.*
- Biochemical Engineering Fundamentals, Baily and Ollis.
- Principles of Fermentation Technology by Stanebury P.F, and Whitaker.

- Fermentation Biotechnology-Principles, Process and Products by Ward,O.P.
- Process Engineering in Biotechnology, Jackson A.T.
- Bioreaction Engineering Principles, Nielson & Villadson.
- Industrial Microbiology by Prescott & Dunn.
- Microbial Biotechnology by Glazer & Nikaido.
- A Text Book of Industrial Microbiology by Cruger and Cruger.
- Manual of Industrial Microbiology & Biotechnology by Arnold *et al.*

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To know about the production of primary and secondary metabolites production, handling and designing of different fermentor and bioreactors,

CO2- To know how the commercial production of wine, beer, processed food, recombinants products and antibiotics are controlled and utilized by human welfare.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO6, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO4, PO6, PO7, PO8 /PSO1, PSO2

MSBC 0011: RDT, GENOMICS & PROTEOMICS

OBJECTIVES: To expose students with recent advances in the field of Recombinant DNA Technology, and Genomics & Proteomics and their implication in life sciences research.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Tools used in GE** Principles of Gene Cloning, Enzymes used in RDT: Restriction Endonuclases, restriction digestion and restriction mapping, other DNA Manipulative enzymes, linkers and adaptors, Blunt end ligation Cloning vectors for E. coli: pBR322, pUC19, pGEM3Z, M13, Phagemids, Phage λ, Cosmid and BAC; Expression cassette, Transcriptional and Translational Fusion, limitations of recombinant protein production in prokaryotic host, Shuttle Vector, Cloning vectors for yeast : comparison of YEp, YIp and YRp, YAC **Techniques in GE** Gene and cDNA library, Molecular Probes, methods for clone identification: colony and plaque hybridization probing, Immunological detection methods, Polymerase Chain Reaction, PCR Primer designing, qPCR, site directed mutagenesis,	18
II	DNA Sequencing, Pyrosequencing, Sequencing by Synthesis (SBS) by Illumina, SOLiD™ **Genomics & Proteomics** Genome sequencing: Shot Gun, Clone Contig, Contig assembly by chromosomal walking, sequence tagged site; Genetic and Physical Mapping, Importance of map in sequence assembly Genome Annotation: identifying genes in a genome sequence, determining the function of an unknown gene Studying the transcriptome: Serial Analysis of gene Expression, Microarray Studying the Proteome: separation of proteins using 2D Gel, identification of individual protein using MALDI-TOF Studying protein-protein interactions: phage display, the yeast two hybrid system	24

Text Book:

- Genetic Engineering by Rastogi, Samita

Reference Books:

- "Principles of Gene Manipulation" by R.W.Old and S.B.Primrose Third Edition Blackwell Scientific Publication
- "Gene Cloning " by T.A.Brown
- Molecular Biotechnology by Glick
- Expanding Horizons by B.D.Singh

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To acquaint theoretical understanding of genetic engineering tools and techniques, i.e. restriction digestion, blotting, map-based cloning, PCR etc.

CO2-To learn how to exploit various ~omics technologies in biotechnology related activities.

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

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO4, PO5, PO6/PSO1, PSO2

MSBC 0012: PLANT BIOTECHNOLOGY

OBJECTIVES: To provide knowledge of different techniques for the utilization of Plant material in agriculture and to combat the disease associated with the crop and utilize the tissue culture techniques for the production of valuable products as well as provide the idea how plant can be useful for the human welfare.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Plant tissue culture:** Cleaning, sterilization, sterile handling of tissue culture of plant. Nutritional requirement for invitro culture. Concept of cellular totipotency, single cell culture, micro propagation, somoclonal variation and its application for plant improvement, somatic embryogenesis, anther and ovule culture, haploid and double-haploid production. **Protoplast culture:** Isolation ,fusion and culture, somatic hybridization, selection system for hybrids , cybrid production and their application in crop improvement, cryobiology of plant cell culture and establishment of gene banks, production of virus free plants using meristem culture. **Plant cloning vectors:** Ti and Ri plasmid and viral vectors (CaMV based vectors, Gemini virus, TMV based vectors). Mechanism of DNA transfer, role of virulence genes, use of 35S promoters, genetic markers, use of reporter genes, methods of nuclear transfer, particle bombardment, electroporation, microinjection, transformation of monocots,	18
II	Transgene stability and gene silencing , herbicide , insect and salt resistance , Plant DNA fingerprinting - Hybridization and PCR based markers (RFLP, SSRs, RAPD, QTLS , SCARS , AFLP etc.) Biological nitrogen fixation and biofertilization, molecular mechanism of nitrogen fixation, genetics of nif gene. Plant diseases- general account, biological control of pests and disease, biopesticides, intellectual Property Rights, seed production technique, plant cell culture for the production of useful secondary metabolism-pigments, perfumes, flavor, pharmacologically important compounds, biodegradable plastics. Automation in Plant Tissue Culture for its commercial application. Commercial production of plant proteins in microorganisms, Transgenic plants, commercial status and public acceptance, Bio-safety guidelines for research involving GMO's, benefits and risks. Socio economic impact and ecological consideration of GMO's.	24

Text Book:

- Biotechnology by Singh, B.D

Reference Books:

- Plant Tissue Culture: Theory & practice by Bhojwani & Rajdan

- Plant Biotechnology by Hammond *et al*
- Plant Tissue Culture –Bhojwani, S.S.
- Plant Cell & Organ culture by Gamberg, O.L
- Principles of Plant Biotechnology, Montell, *et al*
- Plant Cell Culture by Evans D.A.
- Plant Molecular Biology- vol.I and II, Gimartin & Bowler

Focus: This course focus on employability aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To utilize their knowledge of plant biotechnology in the crop quality improvement, production of disease resistant plant and secondary metabolites and their commercial application.

CO2- To know how the traditional methods can be replaced by the modern plant genetic engineering techniques to improve the quality and quantity of plant products.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2
CO2	PO1, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2

MSBE 0001: NANOBIOTECHNOLOGY

OBJECTIVES:

- The mission of the Nanobiotechnology Program is to provide a multidisciplinary education in nanoscale science and technology. The primary goals are:
- Prepare students for a career in nanotechnology by providing them with a sound grounding in multidisciplinary areas of nanoscale science and engineering.
- Increase students' understanding of materials and their properties.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Basic biology principles and practice of micro fabrication techniques, Atomic force microscopy, Biological production of metal nano particles, macro molecular assemblies, quantum dots technology and its application, Application in Biomedical and biological research, tumor targeting and other diagnostic applications.	10
II	Viruses as nano-particles ,nano chemicals and application, Developing drug delivery tools through nano biotechnology, nano particle based immobilization assays. Synthesis and characterization of different classes of biomedical polymers- their uses in pharmaceutical, cardiovascular ophthalmologic, orthopedic areas. Biosensors and nano biotechnology principles used in construction of micro electronic devices ,sensors and macro mechanical structures and their functioning, immuno-nanotechnology	14

Text Book:

1. Subbaih Balaji, “Nano Biotechnology”: MJP Publishers, 2010

Reference Books:

1. Christof M. Niemeyer , Chad A. Mirkin, “Nanobiotechnology - concepts, applications and perspectives”: wiley publishers,2004.
2. Donald Martin,”Nanobiotechnology of biomimetic membranes”: springer verlag publishers, 2007.

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To learn the necessary foundation for training in research.

CO2- To provide theoretical and practical knowledge related to modern nanotechnology.

CO3- To develop the capability of reflecting on central, ethical and scientific problems related to nanobiotechnology.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO7, PO8 /PSO1, PSO2
CO2	PO2, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2
CO3	PO1, PO2, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2

MSBE 0002: ENZYME TECHNOLOGY

OBJECTIVES: The course will provide an overview of the key enzymes currently used in large scale industrial processes. An overview of industrial scale protein production will be presented, including an introduction to applicable microbial expression hosts, downstream processing & purification methods, and enzyme optimization through enzyme discovery and engineering.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• History and introduction to enzymes : Classification of enzymes. IUPAC system, nomenclature, E.C. numbers. • Enzyme kinetics (Michaelis – Menten laws), importance and determination of V and K values, Hofstee's plot, L & B plots. • Bisubstrate reactions-ordered & random sequential mechanism. Theorell chance mechanism, ping pong mechanism, products of inhibition in bisubstaect reactions. • Enzyme inhibition: competitive, non-competitive and other types. • Extraction of soluble and membrane bound enzymes from microbial, plant and animal tissues. • Purification of enzymes : salt precipitation, gel fitration, ion exchange and affinity cromatography. • allosteric enzymes. • Multienzyme complexes. • Methods of storing enzymes.	10
II	• Regulation of enzyme activity, various controls (metabolic compartmentation, covalent modifications and others), feedback regulation, • Mechanism of Enzyme catalysis: acid-base catalysis, substrate strain, covalent catalysis and entropy effects • Large scale production of enzymes including genetic engineering approaches for their over production. • Enzyme engineering; identification of active sites, approaches for modification of catalytic properties. • Techniques of enzyme immobilization and applications of enzymes in : Food industry – High fructose syrup, cheese making and beer industry. Antibiotics and other Pharamaceuticals Medical applications Analysis of substances, enzyme electrodes,enzyme thermistors.	14

Text Book:

- S. Shanmugam, T. Satishkumar and M. Shanmugaprakash, "Enzyme Technology" : I.K. International, 2012

Reference Books:

- T. Palmer, "Understanding Enzymes" : John Wiley & Sons, 1981
- N.C. Price and L. Stevens, "Fundamentals of Enzymology" : Oxford University Press, 1982
- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

Focus: This course focus on employability aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To explain the key structural and energetic factors which give rise to increased enzyme stability important for industrial application, summarize current processes involved in industrial enzyme production, from protein production to purification and formulation,

CO2- To compare and contrast the historical uses of enzyme technology with current applications in a diverse range of industries.

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

COs	POs/ PSOs
CO1	PO1,PO4, PO5, PO8 /PSO2
CO2	PO1,PO3, PO5, PO6, PO8 /PSO1, PSO2

MSBE 0003: CLINICAL RESEARCH IN MEDICINAL PLANTS

OBJECTIVES: To understand the medicinal values of plants.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Alternative systems of medicine (ayurveda, siddha, unani etc.), herbal remedies-toxicity and regulations, Ethnobotany and Ethnopharmacology Need of scientific validation as per WHO & national and international agencies	10
II	Factors affecting herb quality, morphological examinations, microscopical evaluation, Development of standardization parameters Phytochemical constituents and their analysis, Pharmacological screening of herbal drugs	14

Text Book:

- Quality control of herbal drugs by Dr. Pulok K. Mukhaejee, Horizons Publisher

Reference Books:

- WHO guidelines on quality control of medicinal plants
- Quality control methods for medicinal plant materials by WHO, pub-Geneva, 1998

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To have knowledge of traditional medicine (ayurveda and its role) in treatment of diseases.

CO2- To understand the acquaintance of alternative systems of medicine

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

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO8 /PSO1, PSO2
CO2	PO2, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2

MSBE 0004: CLINICAL IMMUNOLOGY

OBJECTIVES: To understand diseases and its diagnosis through clinical immunology

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Basic concepts of immune system, antigens, antibodies, cytokines, major histocompatibility complex, initiation of immune responses and cell involved, Immunodiagnostic techniques- agglutination, precipitation	10
II	RIA, ELISA, Flow cytometry and in relation to interpretation of their diagnosis, immunological aspects of infections Immunology of viral infections (Hepatitis viruses, HIV, Influenza, Polio, Dengue and Chickungunea) Immunology of bacterial diseases (Mycobaterium & Typhoid bacilli)	14

Text Book:

- Essential Clinical Immunology, Cambridge University Press, by John B. Zabriskie

Reference Books:

- Immunology by Kuby (Free man publication)
- Essential of Immunology by Roitt (Blackwell scientific publication)
- Immunology of Benacera
- Infection and Immunity by John Playfair & Gregory Bancroft (Oxford University Press)
- Immunology by C. Fatima

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To understand the basic concepts of immune system.

CO2- To design a diagnostic plan by evaluation of immunological laboratory techniques based on differential diagnosis and motivate why these techniques are appropriate for correct diagnosis.

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

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO6, PO8 /PSO1, PSO2
CO2	PO2, PO3, PO4, PO5, PO6, PO7/PSO1, PSO2

MSBE 0005: NUTRITIONAL BIOCHEMISTRY

OBJECTIVES:

The fundamental role of the subject is aware the students about the energy and nutrient need of the body. To inculcate in their minds the role of balanced diet, vitamins and essential minerals, amino acids and fatty acids. Imparting knowledge about body basic metabolism and diseases that could arise as a result of malnutrition. Thus laying the foundation towards a healthy and disease free life.

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	• Energy need of the body: Anabolism and Catabolism, Basal metabolic rate (BMR), factor affecting BMR, its calculation and balance diet. Energy value of different food sources. • Protein & carbohydrate malnutrition, Vitamin (Water soluble and fat soluble). Vitamins and minerals deficiency, hypervitaminosis. Hormonal regulation of body metabolism (Thyroid hormone); • Hormones regulating blood glucose (Insulin, Epinephrine and Glucagon). • Different categories of Biochemicals present in food: Carbohydrates, Proteins, Fats and lipids, Essential and non essential amino acids, fatty acids.	10
II	• Basic biochemistry of Carbohydrates, Proteins, fats and lipids, to meet the energy requirement of the body (Glycoslysis, Krebcycle, ETS). • Composition of body fluids, ECF, ICF, etc. • Body homeostasis maintenance, pH maintenance, Basic buffers of the body. Conditions for Acidosis, Alkalosis and ketosis in the body. • Metabolic deficiency and diseases based on Carbohydrates, liver function test, bile pigment metabolism jaundice, renal function test.	14

Text Book:

- J.L. Jain, S. Jain and N. Jain, “Fundamental of Biochemistry”: S. Chand & Company Pvt. Ltd, 2016

Reference Books:

- J. M. Berg, L. Stryer, J. L Tymoczko and G.J. Gatto, “Biochemistry” : W.H. Freeman, 2015
- D.L. Nelson and M. Cox, “Lehninger Principles of Biochemistry” : W.H. Freeman,

- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To enhance the knowledge of student to uptake jobs in health sector particularly as a dietitian in hospitals, sports and assistance to food industries and dairies

CO2- To understand the importance of maintaining a healthy diet and would make them health conscious for prolongevity in their life spa

CO3- To find the placements in hospitals, sports as dietitians, etc.

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

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO2
CO2	PO1,PO2, PO6, PO7, PO8 /PSO1
CO3	PO1, PO7, PO8 /PSO2

MSBE 0006: DRUG DISCOVERY AND DEVELOPMENT

OBJECTIVES:

To demonstrate an understanding of the importance of strict quality control and regulation in the drug development process, and an awareness of issues associated with the manufacturing of medicines such as good manufacturing practice.

Credits: 02 **Semester III** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	Computer Aided Drug Design, An Over-view of the different approaches used during computer-aided drug design. Structural Determination of the target enzyme, Design of the inhibitor molecules, Collection of the inhibitor molecules, Docking. Process of Drug Discovery: Reductionist target-based approach, Target identification and validation, lead identification: High through-put screening, lead optimization and prioritization: ADME-TOX properties	10
II	Process of Drug Development: considerations and strategies, cost estimates, factors for choosing candidates for drug development, preclinical studies (cell-based and animal studies), clinical studies (Phase 1, 2, 3) New strategies in drug discovery: Structure based drug designing, Molecular docking, Computer aided drug designing, chemi-informatics etc. global dynamics of proteins between structure and functions Biosensors and Devices: Introduction and its applications.	14

Text Book:

- Bioinformatics, second edition M.M. Ranga

Reference Books:

- Basic Principles of Drug Discovery and Development by Benjamin Blass

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To demonstrate an awareness of the important contributions the different discipline areas make to the drug discovery and development process.

CO2- To demonstrate an awareness of the current approaches to global drug discovery and their advantages and limitations.

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

COs	**POs/ PSOs**
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO4, PO6, PO7, PO8 /PSO2

MSBE 0007: IPR, PATENT, TRADEMARKS & BIOETHICS

OBJECTIVES: Intellectual property rights enlightens the student knowledge towards the development of novel ideas and goods in the field of biotechnology

Credits: 2 **Semester III** **L–T–P: 2-0-0**

Module No.	Content	Teaching Hours
I	**IPR :** Introduction to IPR, History of IPR in India. Essential elements of IPR- Trade secret, Patent, Copyright, Trademark. International harmonization of patent laws – WTO, GATT, TRIPs, WIPO. India and TRIPs, Protection of biotechnological inventions, IPR and developing countries, Broad patents in biotechnology, Choice of IPR protection, Management of IPR , Benefits and problems from IPR, Indian response to IPR upheaval. **Biosafety-** Introduction to Biosafety, Definition and objectives of biosafety guidelines. Risk Assessment- Assessment of risk during laboratory research, Risk Assessment of Biotechnolohy products. Risk regulation. Containment- Physical containment, Biological containment.	10
II	Biosafety guidelines in India, Biosafety Level – BL1, BL2, BL3 and BL4. Research involving plants – BL1-P, BL2-P, BL3-P and BL4-P. Research involving Animals- BL1-N, BL-2N, Bl3-N and BL4-N. **Bioethics-** Bioethics in Biodiversity Resource management – Definition, Ethical issues of biodiversity. Ethical issues in genetically modified organisms- Introduction, History of genetic modification, Techniques of genetic modification, Uses of genetic modification. Genetically modified food, Health implications of genetically modified food, Public health principles regarding the regulation of genetically modified food. Labeling of genetically modified food products. Benefits of labeling, Guidelines for labeling of genetically modified agricultural products. Animal cloning and their ethical aspects.	14

Text Book

- Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press.ISBN-1555811804,9781555811808.

Reference Books:

- Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219

- Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
- Intellectual property rights-Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602, B.D. Singh. Biotechnology expanding horizons
- Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic ress..
- H.K.Das. Text book of biotechnology 3rd edition

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To enhance the practical applications of students to uptake challenging problems associated with patenting, intellectual property rights in the field of biotechnology.

CO2- To understand the ethical issues in genetically modified organisms

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

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO4, PO6, PO7, PO8 /PSO2

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MSBC 0807: PLANT BIOTECHNOLOGY AND BIOPROCESS ENGINEERING & FERMENTATION TECHNOLOGY LAB

OBJECTIVES:

To well verse the students with practical knowledge of plant biotechnology and fermentation technology that they have taught in the theory and provide hands on training on practical techniques of plant tissue culture and fermentation technology related practical.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Preparation of media for plant tissue culture. • Sterilization of plant tissue. • Callus induction from different explants: - seed, root & shoot. • Isolation of protoplast and culture. • Viability testing of seeds under different environmental conditions • Isolation of nitrogen fixing organisms like Cyanobacteria and Rhizobium and their characterization. • Measurement of nitrate reductase from *Nostoc muscorum*. • Analysis of total protein content of seeds by TCA precipitations method. • Isolation and cultivation of mushroom. • Microbial production of citric acid using *Aspergillus niger*. • Isolation and study of fungus responsible for food spoilage. • Comparative study of ethanol production using different substrates	30

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To prepare different explant culture, essential oil extraction and perform the fermentation experiment.

CO2- To familiar with bio fermenter assembly and working by producing the citric acid and alcohol.

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

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO6, PO7, PO8 /PSO1, PSO2

MSBC 0808: ANIMAL BIOTECHNOLOGY, RDT, GENOMICS & PROTEOMICS LAB

OBJECTIVES: This course aims to impart in students an understanding of the primary cell culture and methods that convert them to long term established cultures. They will be exposed to all the factors which could impact cell culture and equipment requirements for propagation.

Credits: 02 **Semester III** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	• Introduction to cell culture laboratory and instruments (Inverted microscope, CO_2 incubator, Refrigerated centrifuges, Bio-safety cabinets, cryo cans, UV lights etc) used in the lab • Washing and Sterilization of glass wares, plastic ware and different buffer/ media for animal tissue culture • Preparation of tissue culture medium trypsin • Separation of lymphocyte from Peripheral blood monocular cells. • Cell counting and cell assay. • Preparation of single cell suspension from spleen / thymus • Trypsinization of monolayer and sub culturing of cells • Cell proliferation assay by MTT method • Cryopreservation and revival of cells • Macrophage monolayer from **PEC** and measurement of phagocytic activity • Cell staining: giemsa & may grummrald staining • General overview of Cytoscape: a frame for network biology • Analysis of protein-protein interaction network using various apps of Cytoscape viz. *Network Analyzer, DisGeNet, JActiveModule* • Enrichment analysis of high-throughput gene list using cytoscape	30

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To demonstrate the ability for development of primary cell culture.

CO2- To understand the concept of cryopreservation.

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

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO4, PO6, PO7, PO8 /PSO2

MSBE 0801: NANOBIOTECHNOLOGY LAB

OBJECTIVES: The objective of this laboratory includes synthesis, production and applications of nanoparticles.

Credits: 01 **Semester III** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	• Chemical Synthesis of silver Nano Particales (sodium borohydride) • Chemical Synthesis of silver Nano Particles (trisodium citrate) • Characterization of silver Nano Particles (By UV spectrophotometer) • Antibacterial activity of silver Nano Particles • Biological Synthesis of silver Nano Particles • Chemical Synthesis of Gold Nano Particles (Citrate Synthesis) • Characterization of Gold Nano Particles (By UV spectrophotometer • Antibacterial activity of gold Nano Particles • Biological Synthesis of gold Nano Particles	15

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To have knowledge of nano material properties and characterization.

CO2- To use the tools, techniques and skills necessary to practice.

CO3- To understand of the impact of nano materials on the environment.

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

COs	POs/ PSOs
CO1	PO1,PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO5, PO7, PO8 /PSO1
CO3	PO1,PO4, PO6, PO7, PO8 /PSO1, PSO2

MSBE 0802: ENZYME TECHNOLOGY LAB

OBJECTIVES:

The objectives of this paper are to design experiments for the determination of enzyme kinetic parameters, conduct various types of enzyme activity assays on the basis of general methodological descriptions, analyze results from these assays in order to estimate enzyme activity, enzyme stability, thermal activation of enzymes, substrate saturation and inhibition constants and evaluate the validity of the enzyme kinetic results such i.e. considerations concerning the use of blank samples, substrate specificity, use of artificial or multiple component substrates and heterogenous enzyme preparations.

Credits: 01 **Semester III** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	• To estimate standard curve of pNP so as to measure the activity of enzyme acid phosphatase • To find out the activity or amount of enzyme acid phosphatase in unit per gram of potato tissue • To find out the specific activity of enzyme acid phosphatase • To study the effect of substrate con. on the activity of enzyme acid phosphatase • To determine value of Km and Vmax of enzyme acid phosphatase by using following graph (i) Michaelis- Menton graph (ii) Lineweaver Burk plot (iii) Hofstee's plot • To study the effect of temperature on the activity of enzyme specific activity and determination of optimum temperature • To study the effect of pH on the activity of enzyme specific activity and determination of optimum pH	15

Focus: This course focus on employability and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To understand enzyme assay system, which will help them to cope up with research and industry related to enzymology.

CO2- To understand the use of artificial or multiple component substrates.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO5, PO7, PO8 /PSO1, PSO2
CO2	PO1,PO4, PO6, PO7, PO8 /PSO1, PSO2

MSBE 0803: CLINICAL RESEARCH IN MEDICINAL PLANTS LAB

OBJECTIVES: To understand the medicinal values of plants

Credits: 01 **Semester III** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	• Authentication of Medicinal plants • Importance of seasons, climate and other environment factors on components of medicinal plants • Preparation of different parts of medicinal plants for their extract preparation • Methods used for preparation of plant extract • Phytochemical analysis of plant extract • Quantitative estimation of component(s) of plants of medicinal value	15

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

PO1- To have knowledge of traditional medicine (ayurveda and its role) in treatment of diseases.

PO2- To have knowledge of authenticating plants.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO5, PO6, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO5, PO7, PO8 /PSO1

MSBE 0804: CLINICAL IMMUNOLOGY LAB

OBJECTIVES: To impart practical knowledge of various components involved in immune system

Credits: 01 **Semester III** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	• Safety measures in clinical immunology lab • Raising of antibodies in experimental animals (rabbit) • Use of adjuvant in raising the antigenicity of weak antigen • Diagnosis of bacterial diseases (two-three) by immune assay • Diagnosis of viral diseases (two-three) by immune assay • Determination of blood incompatibility	15

Focus: This course focus on entrepreneurship and skill development aligned with all COs

Course Outcomes: After completion of this course, the students will be able:

CO1- To understand various immunological assays for the diagnosis of bacterial and viral diseases.

CO2- To have practical knowledge of various components involved in immune system.

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

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO5, PO6, PO8 /PSO1, PSO2
CO2	PO1,PO2, PO3, PO5, PO7, PO8 /PSO1

MSBJ 0971: PROJECT WORK

Credits: 16 **Semester IV** **L–T–P: 0-0-0**

Module No.	Content	Teaching Hours
I	Project work	6 months

PBS 1002: BIOINFORMATICS AND INSTRUMENTATION

OBJECTIVES: The course aims to provide an advanced understanding of the core principles and topics of bioinformatics to increase the understanding of biological processes and instrumentation helps researchers, technician, and students to identify diagnose the problem and provide their solutions. Bioinformatics helps in developing and applying computationally intensive techniques to enable the discovery of new biological insights as well as to create a global perspective from which unifying principles in biology can be discerned. Instrumentation includes all those measures which are used during the research to collect data. The quality of research depends to a large extent on the quality of the research instrument. The more efficient the research instrument, the more authentic the research becomes.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Principles of DNA and Protein sequencing, file formats for storage of Sequence and Structural Data, Primary Sequence Databases of Nucleic Acids and Proteins, Organism Specific Genome Databases, Structural Databases. Specialized Sequence Databases of Expressed Sequence Tags, Gene Expression, Single Nucleotide Polymorphism, OMIM, Unigene etc., Data Retrieval with ENTERZ, SRG and DBGET, Secondary Databases (Pfam, PROSITE, PRINT, BLOCK etc.)	14
II	Chromatography: Adsorption and partition, theory, preparation, procedure and methods of detection, Column, Thin layer chromatography, Paper chromatography. Gas chromatography: Introduction, fundamentals, instrumentation, columns, preparation and operation, detection, dramatization. HPLC: Principals and instrumentation, solvent and columns used, detection and applications. Electrophoresis. Immunoassay Techniques. UV-Visible spectroscopy, introduction, electromagnetic spectrum, absorbance laws and limitation, instrumentation design and working principle, chromophore concept, auxochromes, wood-fisher rules for calculating absorption maximum application of UV-visible spectroscopy. IR spectroscopy: Basic principles- Molecular vibrations, vibrational	14

	frequency, factor influencing vibrational frequencies sampling techniques, instrumentation interpretation of spectra, FT-IR, theory and applications.	
III	Mass spectroscopy: Theory, ionization technique: electron impact ionization chemical ionization field ionization fast atom bombardment plasma desorption fragmentation process type of fission resolution. NMR: Theory, instrumentation, chemical shift, shielding and deshielding effect, splitting of signals, spin-spin coupling, proton exchange reactions, coupling constant (J), ^{13}CNMR spectra and its applications.	14

TEXT BOOK:

- Instrumental Method of Chemical Analysis by B.K. Sharma.
- Organic spectroscopy by Y.R. Sharma

REFERENCE BOOKS:

- A Text book of Pharmaceutical Analysis by Kerrenth A. Connors.
- Vogel's Text book of Quantitive Chemical Analysis by A.I. Vogel.
- Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake.
- Organic Chemistry by I.L. Finar Organic spectroscopy by William KempQuantitative.
- Analysis of drugs by D.C. Garraett.
- Quantitative analysis of Drugs in Pharmaceutical Formulations by P.D. Sethi.
- Spectrophotometric identification of Organic Compound by Silverstein

Focus: This course focuses on employability and skill development.

OUTCOME:

CO1: Understand the principles of methodology of different DNA and Protein sequencing methods. ***(Remembering, Understand, Analyze)***
CO2: Understand about different file formats for storage of Nucleic acid and protein Sequences and Structural Data. ***(Remembering, Remembering, Apply, Analyze)***
CO3: Understand about Primary Sequence Databases of Nucleic Acids and Proteins. ***(Remembering, Understand, Analyze)***
CO4. Understand about Organism Specific Genome Databases and Structural Databases. ***(Remembering, Understand, Analyze)***
CO5. Understand about Specialized Sequence Databases of Expressed Sequence Tags ***(Remembering, Understand, Analyze)***
CO6. Understand about Gene Expression, Single Nucleotide Polymorphism ***(Remembering, Understand, Analyze)***
CO7. Understand about OMIM, Unigene etc ***(Remembering, Understand, Analyze)***
CO8. Understand about Data Retrieval with ENTERZ, SRG and DBGET ***(Remembering, Understand, Analyze)***
CO9. Understand about different chromatographic techniques like Column, Thin layer, Paper, Gas and HPLC chromatography and it's application. ***(Remembering, Understand, Apply and Analyze)***

CO10. Understand about different types of Electrophoresis and it's applications. ***(Remembering, Understand, Apply and Analyze)***

CO11. Understand about different types of Spectroscopy (UV-Visible spectroscopy, IR spectroscopy, Mass spectroscopy) and it's applications. ***(Remembering, Understand, Apply and Analyze)***

CO12. Understand about Nuclear magnetic resonance (NMR) spectroscopy and its applications. ***(Remembering, Understand, Apply and Analyze)***

PBS 1003: BIOLOGICAL CHEMISTRY

OBJECTIVES: The course aims to provide an advanced understanding of the core principles and topics of Biochemistry, Advanced Immunology, Microbiology and Molecular Biology, Translational research on medicinal plants and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of lecture series.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	a. Chemistry of life b. Mechanism in biological Chemistry c. Porphyrin's structure determination of Hemoglobin's chlorophyll d. Enzymes and their kinetics e. Purines & pyrimidines f. Nucleosides, Nucleotides g. DNA & RNA Molecules h. Amino Acid & Proteins	14
II	a. Protein Biosynthesis b. Nucleic acid synthesis c. Carbohydrates & Glyco- proteins d. Metabolism of Carbohydrates and proteins e. Signaling molecules (Extra cellular & intra cellular) f. Cytokines	14
III	a. Conventional and molecular based techniques for diagnosis of infectious diseases. b. Cytokines chemokines and growth factors for regulation of mechamjms of immune responses. Prospects of cytokine therapy in treatment of cancer and immunological disorders. c. Mycobacterium infections distinguishing and other chasacterstics of differvent species of genus mycobacterium modern techniques for their epidemiological studies. d. Immunoassays. e. Stem cells and stem cell thexapy. f. Invitrofertilization and its significance in present scenario. **g.** Traditional systems of medicine and need of scientific validation to compete modem medicine.	14

TEXT BOOK:

- Harper's illustrated Biochemitry Robert K. Murray; Mc. Graw Hill.
- Fundamental of Biochemistry; J.L. Jain & Sanjay Jain, S. Chand.

REFERENCE BOOKS:

- Biochemistry; U. Satyanarayan, Books and Allied (P) Ltd..

- Lehniger Principles of Biochemistry
- David L. Nelsan & Michael M. Cox Freeman.NMS: Biochemistry Davidson, Victor. LB.I. Wavertey Pvt.
- Algae Biology & Biotechnology; O.P. Singh & Gurpeet Singh & Jis Khattar I.K. International Publishing house.
- Pharmacogonosy; C.K. Kokate & A.P. Purohit; Nirali Prakashan
- Pharmacogonosy; W.C. Evans; Elsevier.
- Bioinformatics Sequence and Gename Analysis David W. Mount; CBS Publisher.
- Bioinformatics concept, Skell & Applications S.C. Rastogi, Namita Mendisatta CBS Publications.
- Bioinformatics; M.M. Ranga, Agrobios (India)
- Instrumental method of chemical analysis Gurdeep R. Chatwat & Sham K. Willand Merrit Dea Himalaya Publishing house.
- Spectroscopy of organic compound P.S. Kalsi; New Age International Publisher.
- Analytical Instrumentation; Gilian Mcmohan; Wiley International

Focus: This course focuses on employability.

OUTCOME: The major outcomes of this course are:

CO1: Understand the degradative pathways (Glycolysis & TCA cycle) of carbohydrate metabolism, various pathways for biosynthesis and degradation of amino acids. ***(Remembering, Understand, Analyze)***

CO2: Understand different types of fatty acid oxidation, energy yields and its regulation. ***(Apply, Remembering, Analyze)***

CO3: Understand De-novo and Salvage pathway of nucleotide biosynthesis with regulation and to know about various steps of degradation of purine and pyrimidine nucleotides. ***(Remembering, Understand, Apply, Analyze)***

CO4. Understand complexity and organization of genome in different organism and their repair mechanism. ***(Remembering, Understand, Analyze)***

CO5. Analyze the genetic code and describe the Translation and post translation modification process. ***(Understand and Analyse)***

CO6. Illustrate various mechanisms that regulate immune responses and knowledge of immunization. ***(Understand and Analyse)***

CO7. Understand the extraction processes, medicinal values and scientific validation of herbal plants and products. ***(Remembering, Understand, Analyze)***